

AD-A087 634

NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON

F/G 13/13

NATIONAL DAM SAFETY PROGRAM. LAKE TAMARACK DAM (NJ00301) HUDSON--ETC(U)

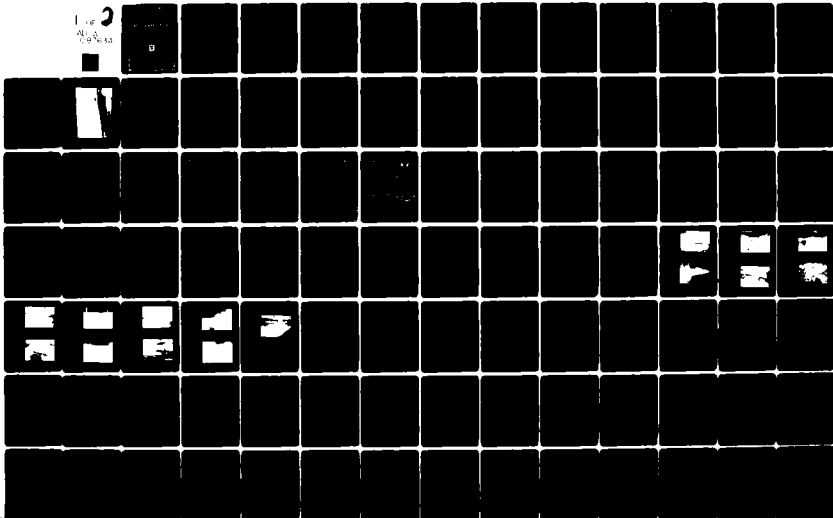
FEB 80 W A GUINAN

DACW61-79-C-0011

NL

UNCLASSIFIED

2
ALL
09/80



A
76

ADA 087634

HUDSON RIVER BASIN
TRIBUTARY TO FRANKLIN POND CREEK
SUSSEX COUNTY
NEW JERSEY

LAKE TAMARACK DAM

NJ 00301

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

THIS DOCUMENT IS BEST QUALITY PRACTICABLE.

THIS COPY FURNISHED TO DDC CONTAINED A
SIGNIFICANT NUMBER OF PAGES WHICH DO NOT
REPRODUCE LEGIBLY.



APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

DTIC
ELECTIC
AUG 8 1980

FEBRUARY 1980

APPROVED FOR PUBLIC RELEASE
DISTRIBUTION UNLIMITED.

B

DDC FILE COPY

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00301	2. GOVT ACCESSION NO. AD-A087634	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program. Lake Tamarack Dam (NJ00301) Hudson River Basin Sussex County, New Jersey Tributary to AUTHOR(s) Franklin Pond Creek, Sussex County, New Jersey. Phase I Inspection Report.	5. TYPE OF REPORT & PERIOD COVERED 9 FINAL rept.	6. PERFORMING ORG. REPORT NUMBER
7. PERFORMING ORGANIZATION NAME AND ADDRESS Anderson-Nichols 6 London Ave. Concord, N.H. 03301	8. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625	12. REPORT DATE 11 Feb. 1980	13. NUMBER OF PAGES 89
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106	15. SECURITY CLASS. (of this report) Unclassified	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams National Dam Safety Program Embankments Lake Tamarack Dam, New Jersey Visual Inspection Erosion Structural Analysis Spillways		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

410811 Lu
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



IN REPLY REFER TO
NAPEN-N

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

ACCOMPLISHED	
THIS	Write Section <input checked="" type="checkbox"/>
DATE	Self Section <input type="checkbox"/>
UNAPPROVED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
Dist	APRIL and/or SPECIAL
A	23 04

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

31 JUL 1980

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Tamarack Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Tamarack Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the two spillways are considered seriously inadequate because a flow equivalent to ten percent of the Probable Maximum Flood (PMF) would cause the dam to be overtopped. The seriously inadequate spillways are assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To ensure adequacy of the structure, the following actions, as a minimum, are recommended.

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also during periods of unusually heavy precipitation, around the clock surveillance should be provided.

NAPEN-N

Honorable Brendan T. Byrne

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design or specify procedures for repairing the downstream slope of the dam, including eroded areas, sloughed areas, and areas damaged by trespassing. This study should include an evaluation of the steepness of the downstream slope.

(2) Specify and oversee procedures for establishment of grassy vegetation on the crest and south abutment of the dam, and on the dike adjacent to the pipe stoplog spillway structure. This work should include repair of the erosion on the south side of the pipe stoplog spillway structure.

(3) Specify and oversee procedures for removal of trees from the dam and the dike.

(4) Check the functioning of the low-level outlet and rehabilitate, including placement of the valve at the upstream end.

(5) Provide additional drawdown capacity to reduce drawdown time.

(6) Design or specify procedures for correcting the undermining of the concrete spillway sill abutments on the downstream face.

Initiate any recommended remedial action within three months of study completion.

c. The following remedial actions should be initiated within 30 days from the date of approval of this report:

(1) Start a program of checking the condition of the dam on a regular basis.

(2) Control trespassing on the dam to reduce erosion.

d. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Clear trees from both sides of the discharge channel downstream of the main spillway in the dam and the discharge channel downstream of the pipe stoplog spillway in the dike for a distance downstream from the dam.

(2) Repair spalled and eroded concrete on the upstream wall near the east abutment of the dam and on the concrete spillway abutments at the west end of the dike.

(3) Seal construction joints in the upstream wall of the dam on the upstream face.

NAPEN-N

Honorable Brendan T. Byrne

(4) Clean and paint the rusted steel grating on the stoplog spillway at the left end of the dike.

e. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

1 Incl
As stated


JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:

Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE TAMARACK DAM (NJ00301)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 7 November 1979 by Anderson-Nichols and Company, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Tamarack Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the two spillways are considered seriously inadequate because a flow equivalent to ten percent of the Probable Maximum Flood (PMF) would cause the dam to be overtopped. The seriously inadequate spillways are assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To ensure adequacy of the structure, the following actions, as a minimum, are recommended.

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design or specify procedures for repairing the downstream slope of the dam, including eroded areas, sloughed areas, and areas damaged by trespassing. This study should include an evaluation of the steepness of the downstream slope.

(2) Specify and oversee procedures for establishment of grassy vegetation on the crest and south abutment of the dam, and on the dike adjacent to the pipe stoplog spillway structure. This work should include repair of the erosion on the south side of the pipe stoplog spillway structure.

(3) Specify and oversee procedures for removal of trees from the dam and the dike.

(4) Check the functioning of the low-level outlet and rehabilitate, including placement of the valve at the upstream end.

(5) Provide additional drawdown capacity to reduce drawdown time.

(6) Design or specify procedures for correcting the undermining of the concrete spillway sill abutments on the downstream face.

Initiate any recommended remedial action within three months of study completion.

c. The following remedial actions should be initiated within 30 days from the date of approval of this report:

(1) Start a program of checking the condition of the dam on a regular basis.

(2) Control trespassing on the dam to reduce erosion.

d. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Clear trees from both sides of the discharge channel downstream of the main spillway in the dam and the discharge channel downstream of the pipe stoplog spillway in the dike for a distance downstream from the dam.

(2) Repair spalled and eroded concrete on the upstream wall near the east abutment of the dam and on the concrete spillway abutments at the west end of the dike.

(3) Seal construction joints in the upstream wall of the dam on the upstream face.

(4) Clean and paint the rusted steel grating on the stoplog spillway at the left end of the dike.

e. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

APPROVED:


JAMES G. TON

Colonel, Corps of Engineers
District Engineer

DATE:

30 July 80

UNSAFE DAM

NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Lake Tamarack Dam b. ID NO.: NJ00301 c. LOCATION State: New Jersey, County: Sussex.
 d. HEIGHT: 11.4 feet e. MAXIMUM IMPOUNDMENT CAPACITY: 340 ac. ft. River or Stream: Franklin Pond Creek.
 Nearest D/S City or Town: Franklin Township.

f. TYPE: Earthfill and Concrete. g. OWNER: Lake Tamarack Association.

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 2 June 1980

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT: Preliminary report calculations indicate 10% of the PMF would overtop the dam.

l. URGENCY CATEGORY: High Hazard, UNSAFE, Non-Emergency.

m. EMERGENCY ACTIONS TAKEN:

Gov. notified of this condition by District Engineer's letter of 2 June 1980

n. REMEDIAL ACTIONS TAKEN:

K.J.D.E.P. will notify dam's owner upon receipt of our letter.

o. REMARKS: Final report, to be issued within six weeks, will have WHITE cover.

j. DESCRIPTION OF DANGER INVOLVED: High Hazard potential, overtopping and failure of the dam would significantly increase hazard potential to loss of life and property downstream of dam.

k. RECOMMENDATIONS GIVEN TO GOVERNOR:

Within 30 days of the date of the District Engineer's letter the owner should do the following:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, around-the-clock surveillance should be provided during periods of unusually heavy precipitation.

T.B. HEVERIN, Coordinator
 Dam Inspection Program
 U.S.A.E.D., Philadelphia



IN REPLY REFER TO
NAPEN-N

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

2 JUN 1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Lake Tamarack Dam (Federal I.D. No. NJ00301), a high hazard potential structure has recently been inspected. The dam is owned by the Lake Tamarack Association and is located on a tributary to Franklin Pond Creek near Franklin Township.

Using Corps of Engineers screening criteria, it has been determined that the dam's spillways are seriously inadequate because a flow equivalent to 10 percent of the Probable Maximum Flood would cause the dam to be overtopped. The seriously inadequate spillways are assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owner take the following measures within 30 days of the date of this letter:

- a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

NAPEN-N

--Honorable Brendan T. Byrne

b. In the interim, a detailed emergency operation plan and downstream warning system should be promptly developed. Also, around the clock surveillance should be provided during periods of unusually heavy precipitation.

A final report on this Phase I Inspection will be forwarded to you within two months.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies Furnished:

Mr. Dirk C. Hofman, Actg. Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Tamarack Dam
Identification No.: FED ID No. NJ00301
State Located: New Jersey
County Located: Sussex
Stream: Tributary to Franklin Pond Creek
River Basin: Hudson
Date of Inspection: November 7, 1979

ASSESSMENT OF GENERAL CONDITIONS

Lake Tamarack is an old dam of undetermined age in poor overall condition. The dam is small in size and is classified as high hazard. Two sections, a dike section to the north and a dam section to the south comprise the dam. The crest of the dam section is sandy and bare of vegetation. Significant erosion channels are present on the upstream slope near the south abutment. The downstream slope of the dam is in poor condition, as evidenced by: recently placed fill, erosion, sloughing, and areas damaged by trespassing near the center of dam; large trees on the slope near the south and the north abutments; large trees at the toe of the downstream slope near the north abutment; and the poor condition and apparent lateral movement of the dry stone-masonry wall which retains the toe of the slope near the north abutment. The downstream slope is very steep (1.5H:1V). A minor seepage exists at the downstream toe of the dam near the north abutment. The upstream concrete wall has numerous cracks, separated construction joints, and spalled areas. The north side of the channel immediately downstream of the dam is being eroded and trees which overhang the channel are being undermined. Trees and brush overhang the channel. The dike section has a concrete upstream face. Erosion has occurred on the south side of the pipe spillway on the dike section. Large trees are growing on the dike. The two spillways combined can pass approximately 9 percent of the PMF, which is 18% of the selected SDF, and are seriously inadequate.

We recommended that the owner retain the services of a professional engineer experienced in the design and construction of dams, to accomplish the following in the future: evaluate the steepness of the downstream slope; design or specify procedures for repairing the downstream slope of the dam, including eroded areas, sloughed areas, and areas damaged by trespassing; specify and oversee procedures for establishment of grassy vegetation on the crest and south abutment of the dam and on the dike adjacent to the pipe spillway; repair of the erosion on the south side of the pipe spillway; specify and oversee procedures for removal of trees from the

dam and the dike; check functioning of low-level outlet and rehabilitate, including placement of valve at upstream end; provide additional drawdown capacity to decrease drawdown time; conduct a more detailed hydrologic and hydraulic analysis of the watershed, reservoir, dam and spillways to determine the extent and type of remedial measures necessary; and design or specify procedures for correcting the undermining of the concrete spillway sill abutments on the downstream face.

We further recommended that the owner accomplish the following tasks as a part of operating and maintenance procedures: immediately, start checking the condition of the dam on a regular basis; and controlling trespassing on the dam; in the near future, clear trees from both sides of the discharge channels downstream of the stoplog spillway on the dam and the pipe spillway on the dike; establish a surveillance program for use during and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency conditions; repair spalled and eroded concrete of upstream wall near east abutment of the dam and concrete abutment at west end of the dike; seal construction joints of upstream wall of the dam on upstream face; and clean and paint rusted steel grating stoplog spillway at left end of dike. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

ANDERSON-NICHOLS & COMPANY, INC.



Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848



7 NOVEMBER 1979

OVERVIEW
LAKE TAMARACK DAM

CONTENTS
PHASE I INSPECTION REPORT
LAKE TAMARACK DAM N.J. NO. --- FED ID NO. NJ00301

	<u>Page</u>
PREFACE	
SECTION 1 PROJECT INFORMATION	
1.1 <u>General</u>	1
1.2 <u>Project Description</u>	1
1.3 <u>Pertinent Data</u>	3
SECTION 2 ENGINEERING DATA	
2.1 <u>Design</u>	6
2.2 <u>Construction</u>	6
2.3 <u>Operation</u>	6
2.4 <u>Evaluation</u>	6
SECTION 3 VISUAL INSPECTION	
3.1 <u>Findings</u>	7
SECTION 4 OPERATIONAL PROCEDURES	
4.1 <u>Procedures</u>	8
4.2 <u>Maintenance of Dam</u>	8
4.3 <u>Maintenance of Operating Facilities</u>	8
4.4 <u>Warning System</u>	8
4.5 <u>Evaluation of Operational Adequacy</u>	8
SECTION 5 HYDROLOGIC/HYDRAULIC	
5.1 <u>Evaluation of Features</u>	9
SECTION 6 STRUCTURAL STABILITY	
6.1 <u>Evaluation of Structural Stability</u>	11
SECTION 7 ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES	
7.1 <u>Dam Assessment</u>	13
7.2 <u>Recommendations/Remedial Measures</u>	13
FIGURES	
1. Essential Project Features	
2. Location Map	
APPENDICES	
1. Check List, Visual Inspection	
2. Photographs	
3. Hydrologic Computations	
4. References	

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
LAKE TAMARACK DAM
FED. ID NO. NJ00301

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Lake Tamarack Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 26 October 1979 under Contract No. FPM-39 dated 28 June 1978. This authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 7 November 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Lake Tamarack Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Lake Tamarack Dam is an earthen dam of undetermined age which is composed of two sections: a dam section on the southern part (right) and a dike section on the northern part (left). The dam section is 330 feet long with a hydraulic height of 10 feet and structural height of 11.4 feet. The upstream face is of concrete with vertical slope, and the downstream face is of earth with 1.5H:1V slope. The crest is 12 feet wide and is covered with grass and sand. An 8-foot long stoplog spillway is located on the left end of the dam. The wooden stoplog is 2 inches thick and 9 inches in height. The stoplogs are held in place by concrete slots. A 1-foot diameter CMP low-level outlet pipe approximately 100 feet long is located in the center of the dam and extends northeasterly to the upstream face of the road crossing culvert. The dike section is 300 feet long with a hydraulic height of 2.2 feet (also structural height). The upstream face of the dike is of concrete with a vertical slope and the downstream face is of earth with 3H:1V slope. The crest of the dike is of concrete and about 1-foot wide. A 20-foot long concrete pipe spillway with a diameter of 2.5 feet and which may be controlled with stoplogs at its upstream end, is located on the northern end of the dike section (no stoplogs in place at the time of inspection). The pipe spillway also acts as a culvert for the road located just downstream of the dike. Essential features of the dam are given in Figure 1.

b. Location. The dam is located in Sussex County, New Jersey on a tributary to Franklin Pond Creek, approximately 4 miles south-east of Franklin. It is at north latitude $41^{\circ} 5.68'$ and west longitude $74^{\circ} 32.20'$. A location map is given in Figure 2.

c. Size Classification. Lake Tamarack Dam is classified as "small" in size on the basis of storage at the dam crest of 240 acre-feet, which is less than 1000 acre-feet, and on the basis of its height of 11.4 feet which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Visual inspection of the downstream area and the breach analysis contained in Appendix 3 show that failure of Lake Tamarack Dam could cause excessive property damage and the possibility for loss of more than a few lives at 3 or more houses located near the inlet to Summit Lake approximately 700 feet downstream of the dam. Accordingly, Lake Tamarack Dam is classified as High Hazard.

e. Ownership. Existing inventory information indicates that the Lake Tamarack Association owns the dam. This was verified by conversation with officials of the Town of Hardyston. Attempts to contact a representative of the association at their listed phone numbers (728-7569 in Ringwood and 697-2074 in Lake Tamarack) brought no response. No mailing address could be found.

f. Purpose of Dam. The lake is used for recreation.

g. Design and Construction History. Little information was found regarding the design and construction of the dam.

h. Normal Operational Procedures. No operational procedures were found.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from a Geologic Map of New Jersey (Lewis and Kummel, 1912) indicates that soils within the immediate site area consist of ground moraine overlying bedrock. Bedrock was observed in sporadic outcrops at the right side of the downstream channel during inspection of this dam. The previously mentioned map indicates that bedrock in this area consists of granitoid gneiss of Precambrian age.

1.3 Pertinent Data

a. Drainage Area

Watershed - 0.8 square miles

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Ungated (total) spillway capacity at maximum pool elevation -

Stoplog spillway - 32

Concrete pipe spillway - 31

Low-level outlet (if operable) - 8.2

c. Elevation (NGVD)

Top of dam - 1036

Top of dike - 1036.2

Recreational pool - 1035

Pipe spillway crest - 1032.7

Stoplog spillway crest - 1034.8 with stoplogs

1034 stoplogs removed

d. Reservoir (feet)

Length of maximum pool - 3075

Length of recreational pool - 2450

e. Storage (acre-feet)

Recreation pool - 198

Design surcharge - ($\frac{1}{2}$ PMF) - 281

Top of dam - 240

f. Reservoir Surface (acres)

Top of dam - 38

Recreation pool - 34

Stoplog spillway crest - 34

g. Dam

Type - earthfill with concrete upstream face

Length - dam - 300 feet

 dike - 330 feet

Height - dam - 10 feet (hydraulic height)

 dike - 2.2 feet (hydraulic height)

Topwidth - dam - 12 feet

 dike - 1 foot

Side slopes - dam: upstream - vertical

 downstream - 1.5H:1V

 dike: upstream - vertical

 downstream - 3H:1V

Zoning - concrete upstream and earthfill downstream faces

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - stoplog spillway and pipe spillway

Length of weir - stoplog spillway - 8 feet

 - pipe spillway - 20 feet long by 2.5 feet
 in diameter

Crest elevation - stoplog spillway -

 1034.8' NGVD (with stoplogs)

 1034' NGVD (stoplogs removed)

 - pipe spillway invert - 1032.7' NGVD

Gates - stoplogs

Upstream channel - Lake Tamarack

 Stoplog spillway - spillway wingwalls extend upstream
 to form approach channel

 Pipe spillway - spillway wingwalls extend upstream to
 form approach channel (7' wide)

Downstream channel - tributary to Franklin Pond Creek

i. Regulating Outlets

Type - one one-foot diameter CMP low-level outlet pipe

Length (estimated) - 100'

Access - steel door located 70 feet downstream of the dam

Regulating facilities - not visible

SECTION 2 ENGINEERING DATA

2.1 Design

No plans, hydraulic or hydrologic data for Lake Tamarack Dam were found.

2.2 Construction

No data concerning construction of Lake Tamarack Dam were found.

2.3 Operation

No engineering operational data were found.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files revealed no recorded information. Attempts to contact the owner were unsuccessful.

b. Adequacy. Because of lack of available recorded data, evaluation of this dam was based solely on visual inspection.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. The crest of the dam is sandy and bare of vegetation at the south abutment, which is a sand beach apparently used for recreation. There are significant erosion channels on the upstream slope immediately south of the end of the concrete wall which retains the embankment along the upstream edge of the crest. The downstream face of the dam slopes at 1.5H:1V and is in poor condition, as evidenced by: recently placed fill, erosion, sloughing, evidence of trespassing and the presence of trees on the slope near the south and north abutments; and trees at the toe of the downstream slope near the north abutment. In addition the dry stone-masonry wall which retains the toe of the slope near the north abutment is in poor condition and exhibits apparent lateral movement. There is a minor seepage at the downstream toe of the dam near the north abutment. There are numerous cracks, separated construction joints, and spalled areas in the upstream concrete wall.

b. Appurtenant Structures. There is a recently placed sandfill on the north side of the concrete pipe stoplog-spillway structure at the north end of the dike and minor erosion on the south side of the pipe stoplog-spillway structure. A clump of small trees is growing on the downstream slope of the dike and several trees are growing on the crest of the dike near the north abutment. The downstream slope of the dike has an uneven surface. The abutments of the stoplog structure are undermined and the steel grating over the structure is rusted.

c. Reservoir Area. The watershed above the reservoir is gently to moderately sloping and wooded. There are many houses along the shore of the lake. The reservoir slopes appear to be stable. No evidence of significant sedimentation was observed.

d. Downstream Channel. The north side of the channel between the stoplog spillway in the dam and the highway culvert immediately downstream of the dam is being eroded and trees which overhang the channel are being undermined. Also trees and brush overhang the channel farther downstream beyond the highway culvert.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were found.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were found.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were found.

4.4 Warning System

No description of any warning system was found.

4.5 Evaluation of Operational Adequacy

Because of the lack of operational and maintenance procedures, the remedial measures described in Section 7.2 should be implemented as prescribed.

SECTION 5 HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. Since no data were found an evaluation could not be performed.

b. Experience Data. No experience data were found.

c. Visual Observations. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection approximately 0.1 foot of water was passing over the stoplog spillway and the pipe spillway was flowing approximately 1/5 full.

d. Overtopping Potential. The hydrologic/hydraulic evaluation for Lake Tamarack Dam is based on a spillway design flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of test floods given in the evaluation guidelines for dams classified as high hazard and small in size. The PMF has been determined by application of the SCS Dimensionless Unit Hydrograph Procedure to a 24-hour Probable Maximum Storm of 22 inches. Hydrologic computations are in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 1239 cfs.

The minimum elevation of the dam allows about 1 foot of depth in the stoplog spillway and 3.3 feet of depth above the pipe spillway invert before overtopping occurs. Under this head the capacity of the two spillways totals 63 cfs, which is less than the selected SDF.

Flood routing calculations indicate that Lake Tamarack Dam will be overtopped for 10 hours to a maximum depth of 0.96 feet under half-PMF conditions. It is estimated that together the spillways can only pass about 9 percent of the PMF without overtopping the dam.

Because the dam was classified as high hazard based on the visual inspection, a breach analysis was conducted to assess the increase in downstream hazard caused by overtopping failure. The discharge channel valley narrows from the toe of the dam to its inlet on Summit Lake. Two cross-sections were used to represent this stream reach, one just downstream of the dam and the other at the residential road crossing at the inlet to Summit Lake. The analysis determines the depth of flooding at the cross-sections for two conditions. These are that the dam is overtopped and does not fail, and that the dam is overtopped and does fail. Failure is assumed to occur when overtopping begins. It is estimated that the house immediately downstream of the dam would not experience more than 2-feet of inundation under breach or non-breach conditions. However, at the

3 houses located near the cross-section at the inlet to Summit Lake it is estimated that 3 feet of inundation would occur under $\frac{1}{2}$ PMF non-breach conditions which constitutes a high hazard. Further under 0.1 PMF conditions, which is less than the selected SDF, the inundation at the inlet to Summit Lake is increased from approximately 0.5 foot under non-breach conditions to approximately 3.3 feet under breach conditions which constitutes a significant increase in hazard.

An additional consideration which could not be adequately investigated in this analysis is the possible increase in stage on Summit Lake caused by the release of the full volume of storage in Lake Tamarack. Summit Lake has approximately $\frac{1}{3}$ the surface area of Lake Tamarack at normal pool and depending on the outlet characteristics of Summit Lake Dam an additional increase of several feet could occur at Summit Lake under a breach of Lake Tamarack Dam. This presents the possibility for significant inundation of up to 15 houses which surround Summit Lake.

Lake Tamarack Dam is classified as high hazard, the hazard to loss of life downstream is significantly increased under overtopping failure over that which exists just prior to overtopping failure, together the two spillways can pass approximately 9 percent of the PMF without causing the dam to overtop. Thus the spillways are considered seriously inadequate.

e. Drawdown Capability. Assuming that the low-level outlet currently in place can be restored to an operable condition, it is estimated that the lake can be drained in approximately 22.5 days assuming no significant flow. This time period is considered inadequate for draining the reservoir in an emergency situation.

SECTION 6 STRUCTURAL STABILITY

6.1 Visual Observations

The lack of vegetation on the crest and south abutment of the dam make those areas susceptible to erosion by rainfall and, if it should occur, by overtopping. Significant erosion channels which have already developed on the upstream slope near the south abutment could result in breaching of the dam if the erosion is not stopped. Erosion, trespassing, and sloughing on the downstream slope, combined with the steepness (1.5H:1V) of the slope, could lead to long-term instability of the slope and breaching of the dam if not controlled. Trees growing on the embankment and at the downstream toe could cause seepage and erosion problems if a tree blows over and pulls out its roots, or if a tree dies or is cut and its roots rot.

Erosion on the south side of the pipe stoplog-spillway structure on the dike could result in breaching of the dike. Recently placed sandfill on the north side of the same spillway structure is susceptible to erosion by rainfall and, if it should occur, by overtopping. Trees growing on the dike could cause seepage and erosion problems if a tree blows over and pulls out its roots or if a tree dies or is cut and its roots rot. The downstream slope of the dike is uneven, but this is not considered a problem because of the low height of the dike.

Based on the visual inspection alone, it is not possible to determine the character of the interior cross section or foundations of the dam and dike. It is, therefore, not possible to evaluate the factor of safety of the dam and dike against slope failure.

6.2 Design and Construction Data

No design or construction data pertinent to the structural stability of the dam were available.

6.3 Operating Records

No operating records pertinent to the structural stability of the dam are available.

6.4 Post-Construction Changes

No records of post-construction changes pertinent to the structural stability of the dam were available.

6.5 Seismic Stability

This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static conditions are satisfactory and conventional safety margins exist." None of the visual observations made during the inspection are indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam or of the below-ground configuration of the concrete wall in the dam, it is not possible to make an engineering evaluation of the stability of the slopes or the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Lake Tamarack Dam is an old dam of undetermined age and is in poor condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 should be implemented by the owner as prescribed.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2 a. These problems require the attention of a professional engineer qualified in the design and construction of dams who will have to make additional engineering studies to design or specify remedial measures. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain a professional engineer experienced in the design and construction of dams to accomplish the following in the near future:

1. Design or specify procedures for repairing the downstream slope of the dam, including eroded areas, sloughed areas, and areas damaged by trespassing. This study should include an evaluation of the steepness of the downstream slope.

2. Specify and oversee procedures for establishment of grassy vegetation on the crest and south abutment of the dam, and on the dike adjacent to the pipe stoplog spillway structure. This work should include repair of the erosion on the south side of the pipe stoplog-spillway structure.

3. Specify and oversee procedures for removal of trees from the dam and the dike.

4. Check functioning of low-level outlet and rehabilitate, including placement of valve at upstream end

5. Provide additional drawdown capacity to reduce drawdown time.

6. Conduct a more detailed hydrologic and hydraulic analysis of the watershed, reservoir, dam and spillways to determine the extent and type of remedial measures necessary.

7. Design or specify procedures for correcting the undermining of the concrete spillway sill abutments on the downstream face.

The owner should carry out the recommendations made by the engineer.

b. Operating and Maintenance Procedures. The owner should accomplish the following immediately:

1. Start a program of checking the condition of the dam on a regular basis.

2. Control trespassing on the dam to reduce erosion.

The owner should do the following things in the near future.

1. Clear trees from both sides of the discharge channel downstream of the main spillway in the dam and the discharge channel downstream of the pipe stoplog spillway in the dike for a distance downstream from the dam.

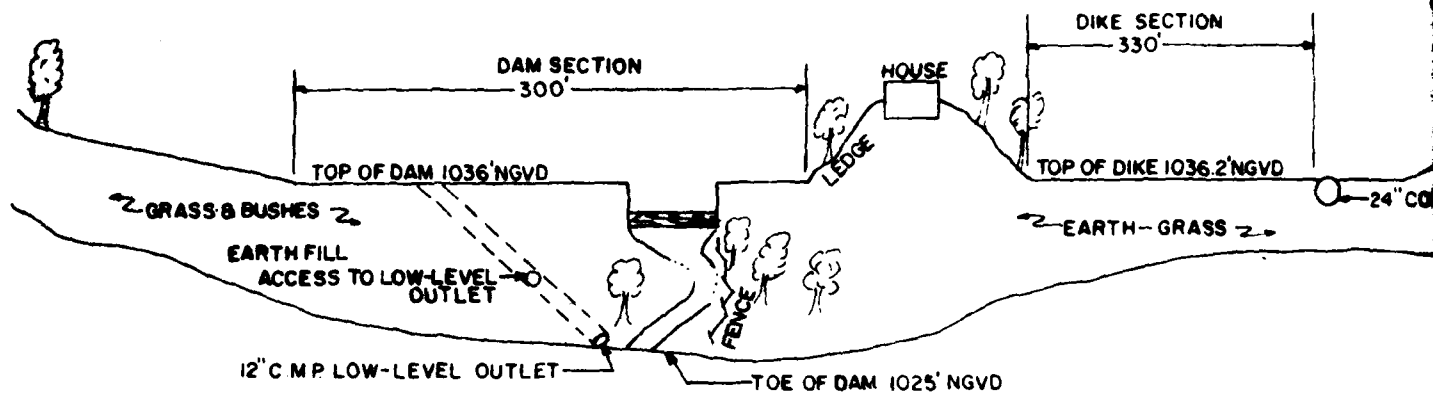
2. Establish a surveillance program for use during and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency conditions.

3. Repair spalled and eroded concrete of upstream wall near east abutment of the dam and concrete spillway abutments at west end of the dike.

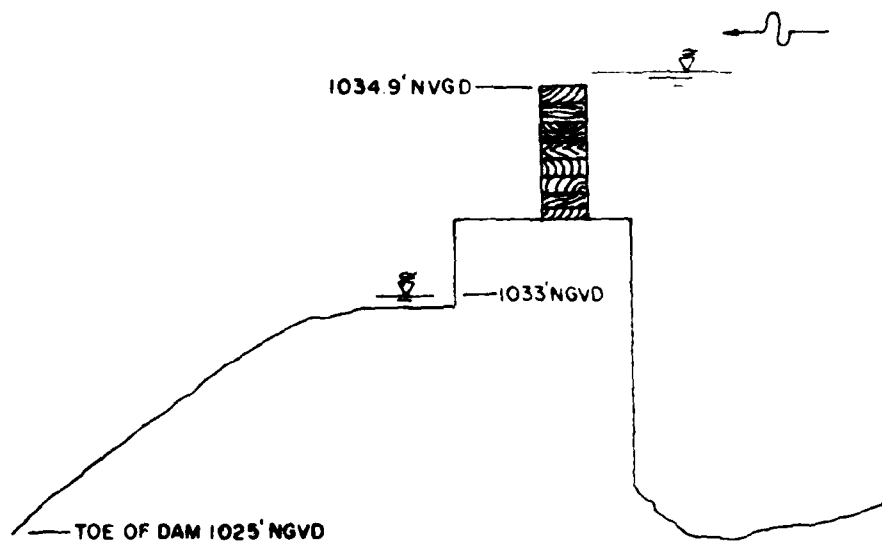
4. Seal construction joints of upstream wall of the dam on upstream face.

5. Clean and paint rusted steel grating stoplog spillway at left end of dike.

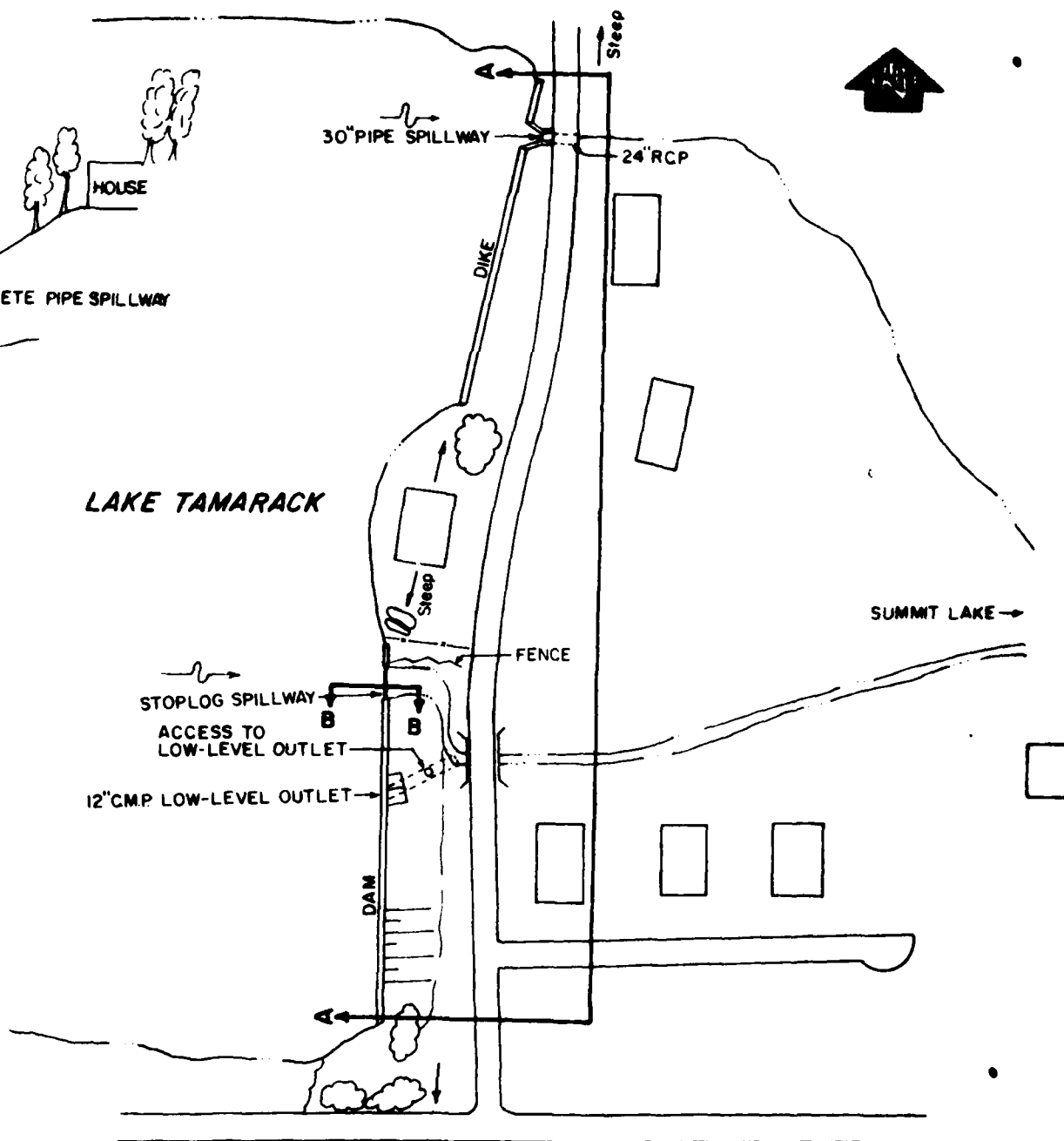
Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.



ELEVATION A-A



SECTION B-B



PLAN

DRAWN FROM FIELD INSPECTION DATA 11/8/79

Anderson-Nichols & Co., Inc.

U.S. ARMY ENGINEER DIST. PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PA.

CONCORD

NEW HAMPSHIRE

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

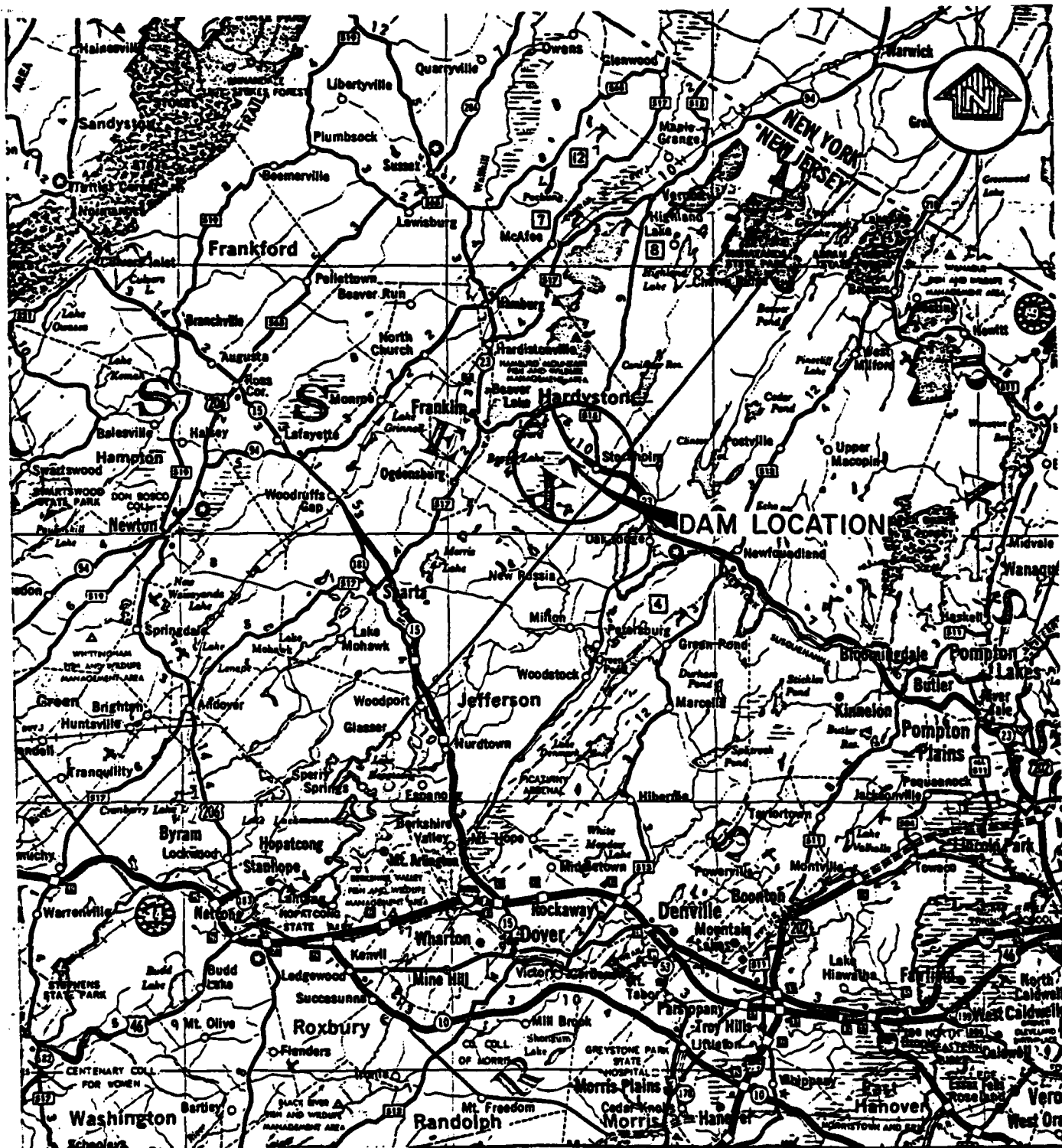
LAKE TAMARACK DAM

TRIBUTARY TO WAWATANDA CREEK

NEW JERSEY

SCALE: NOT TO SCALE
DATE: JANUARY 1980

FIGURE 1



MAP BASED ON STATE OF NEW JERSEY
OFFICIAL HIGHWAY MAP AND GUIDE.

Anderson-Nichols & Co., Inc.		U.S. ARMY ENGINEER DIST. PHILADELPHIA	
CONCORD		CORPS OF ENGINEERS	
NEW HAMPSHIRE		PHILADELPHIA, PA.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
LAKE TAMARACK DAM			
LOCATION MAP			
TRIBUTARY TO FRANKLIN POND CREEK		NEW JERSEY	
		SCALE: SEE BAR SCALE	
		DATE: JANUARY 1980	

FIGURE 2

APPENDIX 1
VISUAL INSPECTION
CHECKLIST

LAKE TAMARACK DAM

Check List
Visual Inspection
Phase 1

Name Dam Lake Tamarack Dam County Sussex State NJ Coordinators NJDEP
Date(s) Inspection November 7, 1979 Weather cool, partly cloudy Temperature 50°F
Pool Elevation at Time of Inspection 1035 NGVD Tailwater at Time of Inspection 1033 NGVD

Inspection Personnel:

Warren Guinan

Stephen Gilman

Kenneth Stuart

Ronald Hirschfeld

Stephen Gilman/Ronald Hirschfeld Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Right embankment - u/s concrete wall - minor area of top of wall has spalled and eroded.	Repair spalled and eroded areas.
STRUCTURAL CRACKING	Right embankment - u/s concrete wall. Numerous thru wall vertical cracks. Some have moved laterally, maximum movement is approximately $\frac{1}{4}$ ".	Repair concrete cracks.
VERTICAL AND HORIZONTAL ALIGNMENT	Fair	
MONOLITH JOINTS		
CONSTRUCTION JOINTS	Right embankment - Construction joints have separated, maximum separation $\frac{1}{8}$ ".	Seal joints.
	Left embankment - Expansion joints, $\frac{1}{4}$ " wide are not sealed on u/s face.	Seal joints.

LAKE TAMARACK DAM, NJ

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Movement of toe of slope near Sta 2+50. Probably associated with sloughing described below.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Evidence of sloughing and erosion near Sta 2+50. Evidence of erosion associated with trespassing near Sta 2+65. Evidence of recently placed fill and erosion at Sta 2+10. All of above on downstream slope.	Repair eroded areas and prevent trespassing.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good.	
RIPRAP FAILURES	No riprap.	

LAKE : IARACK DAM, NJ

Sheet

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

RAILINGS

JUNCTION OF EMBANKMENT
AND ABUTMENT, SPILLWAY
AND DAM

Good condition.

ANY NOTICEABLE SEEPAGE

Minor seepage at toe of dam near
left abutment.

STAFF GAGE AND RECORDER

None observed.

DRAINS

None observed.

DIKE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Downstream slope is rather irregular, possibly the result of past sloughing. Entire face is now covered with good grassy vegetation.	No remedial action needed.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good.	
RIPRAP FAILURES	No riprap.	

LAKE MARACK DAM, NJ

DIKE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Sand fill recently placed next to left side of spillway structure at left end of dike. Minor erosion at right side of spillway structure.	Repair erosion and establish grassy vegetation next to spillway structure.
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

LAKE TAMACK DAM, NJ

STOPLOG SPILLWAY AT LEFT END OF DIKE

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

CONCRETE WEIR

Concrete abutments are surface
eroded exposing coarse aggregate.

Repair eroded concrete.

Steel Grating - Rusted.

Clean and paint rusted
steel.

APPROACH CHANNEL

Wide and unobstructed.

DISCHARGE CHANNEL

Some trees overhanging channel.

Clear trees and brush on both
sides of discharge channel for
a distance downstream from dam.

BRIDGE AND PIERS
OVER SPILLWAY

Stoplogs - weathered wood.

LAKE TAMARACK DAM, NJ

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		
INTAKE STRUCTURE	Not visible.	
OUTLET PIPE	12" CMP - rusted and corroded leaking 3-5 GPM.	
OUTLET CHANNEL	Discharge from CMP is conducted under roadway by CMP. Downstream of roadway trees overhang channel.	Check trees and brush on both sides of channel for a distance downstream from dam.
EMERGENCY GATE	Not visible.	

LAKE T ARACK DAM, NJ

GATED SPILLWAY
STOPLOG SPILLWAY ON DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Stoplog Spillway: Sill-Good condition, minor surface erosion. Abutment-Both sides are badly undermined on d/s face. Maximum depth 8". Stoplog slots-Surface eroded.	No remedial action required. Repair undermining. No remedial action required.
APPROACH CHANNEL	Wide and unobstructed. Sediment has accumulated up to level of crest behind spillway structure.	
DISCHARGE CHANNEL	Right bank is bedrock. Left bank is soil which is being eroded. Trees on left bank are being undermined; one was recently cut. Discharge is carried under roadway by RCP. Downstream of roadway trees and brush overhang channel.	Provide erosion protection for left bank of channel between dam and roadway. Clear trees and brush on both sides downstream from the dam.
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	Stoplogs - Weathered wood, fair condition.	

LAKE T² RACK DAM, NJ

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER	None observed.	

LAKE TAMARACK DAM, NJ

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gently to steeply sloping. Mostly occupied by houses. No signs of instability observed.	
SEDIMENTATION	No evidence of significant sedimentation observed.	

LAKE TAVARZ DAM, NJ

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Channel downstream of stoplog spillway is being eroded. Trees and brush overhang this channel and the channel downstream of pipe spillway on the dike.	Clear trees and brush.
SLOPES	Moderate to gentle - wooded.	
APPROXIMATE NO. OF HOMES AND POPULATION	One house on downstream channel and house on Summit Lake. Estimated population 10-15.	One house located just downstream of the dam could be damaged. There are 15 houses located around Summit Lake of which 3 are located very close to the entrance of the Summit Lake. These three houses could be severely damaged with the possibility of loss of lives. Other houses could be inundated.

ITEM	REMARKS
DESIGN REPORTS	None found.
GEOLOGY REPORTS	None found.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None found.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None found.
POST-CONSTRUCTION SURVEYS OF DAM	None found.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SERVICES	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
------	---------

SPILLWAY PLAN

SECTIONS

DETAILS

Prepared for this report from field inspection.

None.

OPERATING EQUIPMENT

None.

PLANS & DETAILS

None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS Mountainous, heavy forest, partly suburban

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1034.9 (198)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not applicable

ELEVATION MAXIMUM DESIGN POOL: 1036.9' NGVD (½ PMF)

ELEVATION TOP DAM: 1036 NGVD

CREST: Stoplog concrete spillway.

1034.9 NGVD with stoplogs

a. Elevation 1034 NGVD without stoplogs

b. Type Wooden stoplog weir

c. Width 2 inches

d. Length 8 feet

e. Location Spillover Left side of the dam

f. Number and Type of Gates Unknown

OUTLET WORKS: Low-level outlet pipe

a. Type 12-inch diameter CMP pipe

b. Location Center of dam

c. Entrance Inverts Unknown

d. Exit Inverts 1019 NGVD

e. Emergency Draindown Facilities Described above

HYDROMETEOROLOGICAL GAGES: None

a. Type _____

b. Location _____

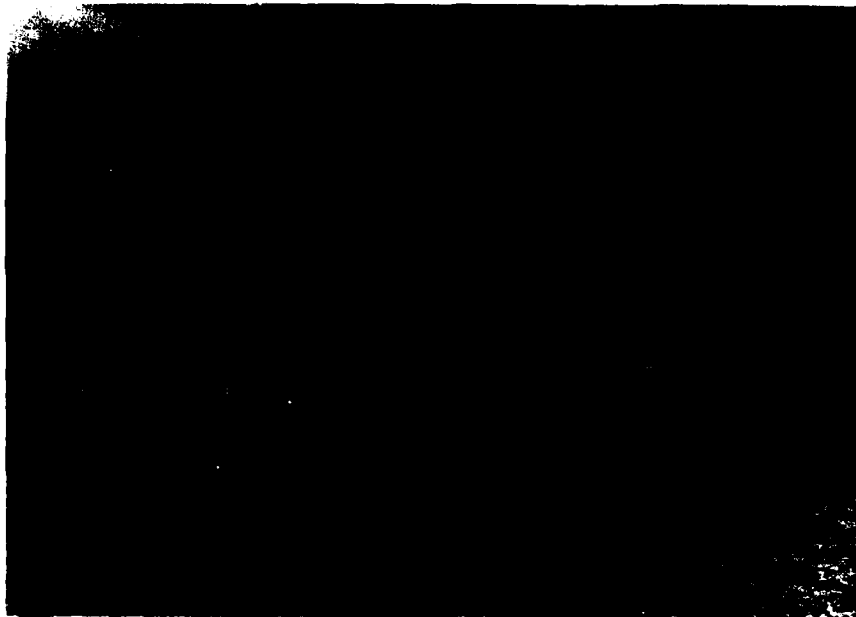
c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: 63

APPENDIX 2

PHOTOGRAPHS

LAKE TAMARACK DAM



7 NOVEMBER 1979
VIEW FROM RIGHT EMBANKMENT LOOKING NORTH.



7 NOVEMBER 1979
VIEW LOOKING FROM LEFT END OF THE DIKE
LOOKING SOUTH.

LAKE TAMARACK

2-1



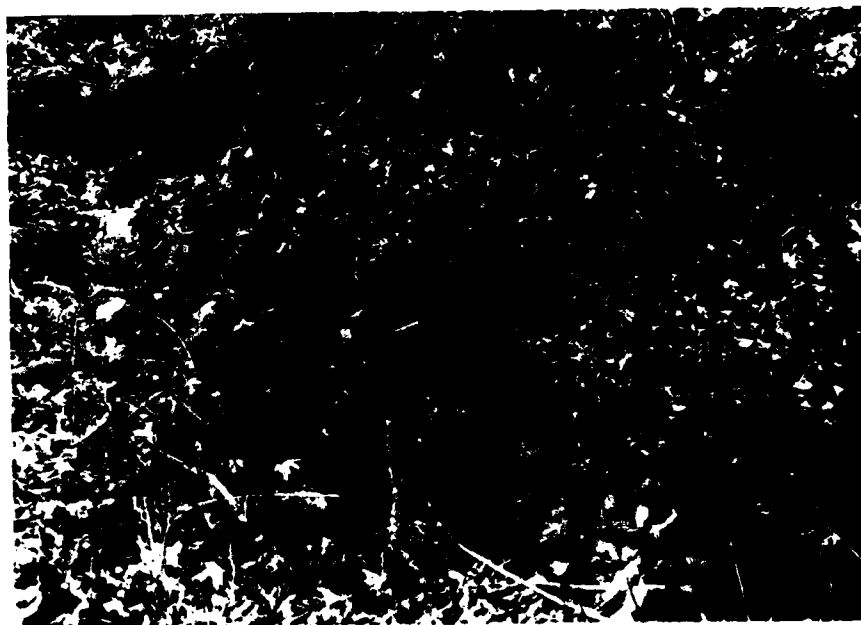
7 NOVEMBER 1979
VIEW OF THE STOPLOG SPILLWAY SECTION ON THE
DAM LOOKING UPSTREAM.



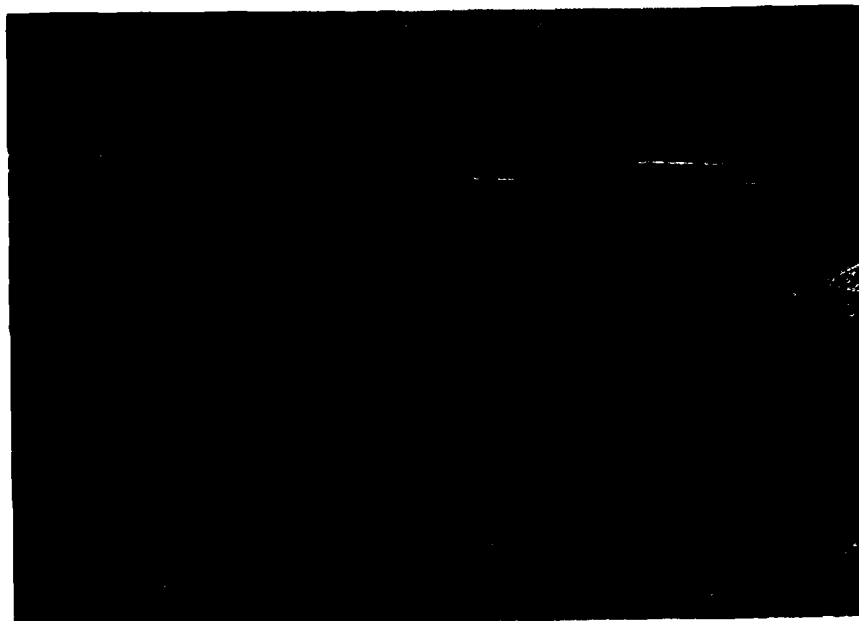
7 NOVEMBER 1979
UPSTREAM FACE OF THE 24" CONCRETE PIPE
SPILLWAY ON THE NORTHERN END OF THE DIKE.



7 NOVEMBER 1979
VIEW OF UPSTREAM RESERVOIR FROM DAM CREST.



7 NOVEMBER 1979
DOWNSTREAM FACE OF CMP LOW-LEVEL OUTLET.
SEEPAGE WATER DISCHARGING NEXT TO END OF CMP.



7 NOVEMBER 1979
 EROSION NEXT TO RIGHT END OF CONCRETE WALL
 ON UPSTREAM SIDE OF THE DAM CREST.



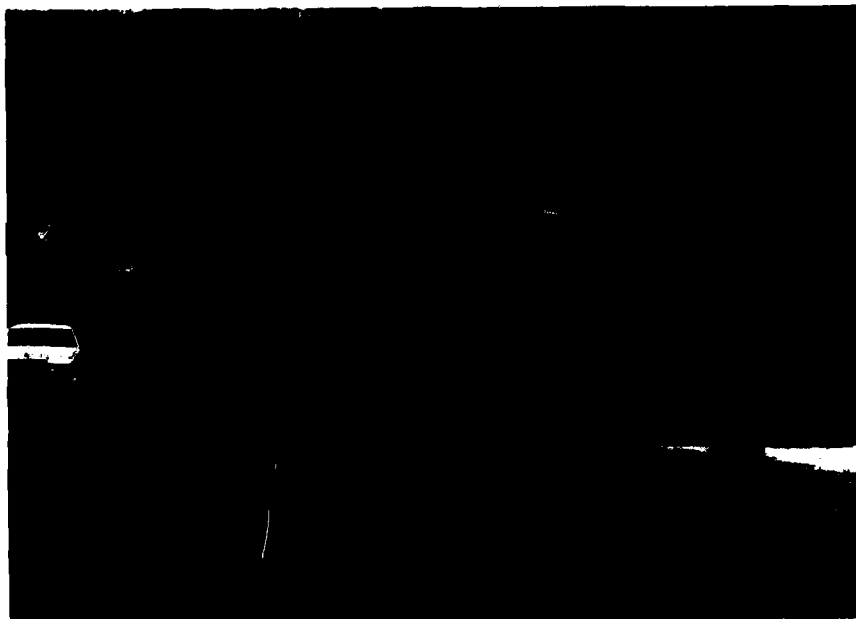
7 NOVEMBER 1979
 DISCHARGE CHANNEL DOWNSTREAM OF STOPLOG SPILLWAY
 SHOWING SOIL EROSION AND UNDERMINING AT STUMP OF
 RECENTLY CUT TREE.



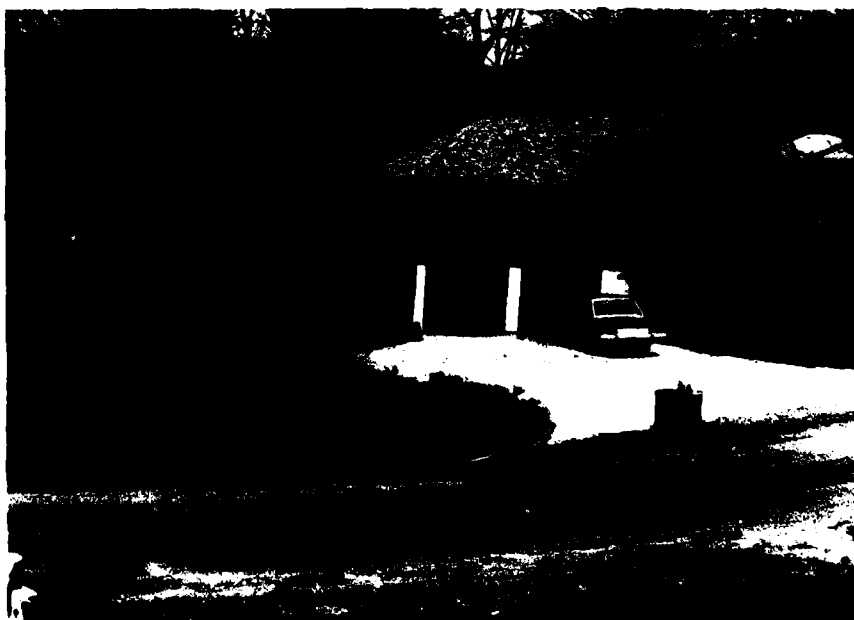
7 NOVEMBER 1979
 EVIDENCE OF TRESPASSING & EROSION ON DOWNSTREAM
 SLOPE OF DAM. REMNANT OF STONE WALL AT BASE OF
 DOWNSTREAM SLOPE VISIBLE BEHIND GUY WIRE FOR POLE.



7 NOVEMBER 1979
 RECENTLY PLACED FILL ON DOWNSTREAM SLOPE
 OF DAM WITH EVIDENCE OF EROSION.



7 NOVEMBER 1979
ROAD CROSSING JUST 50 FEET DOWNSTREAM OF DAM.



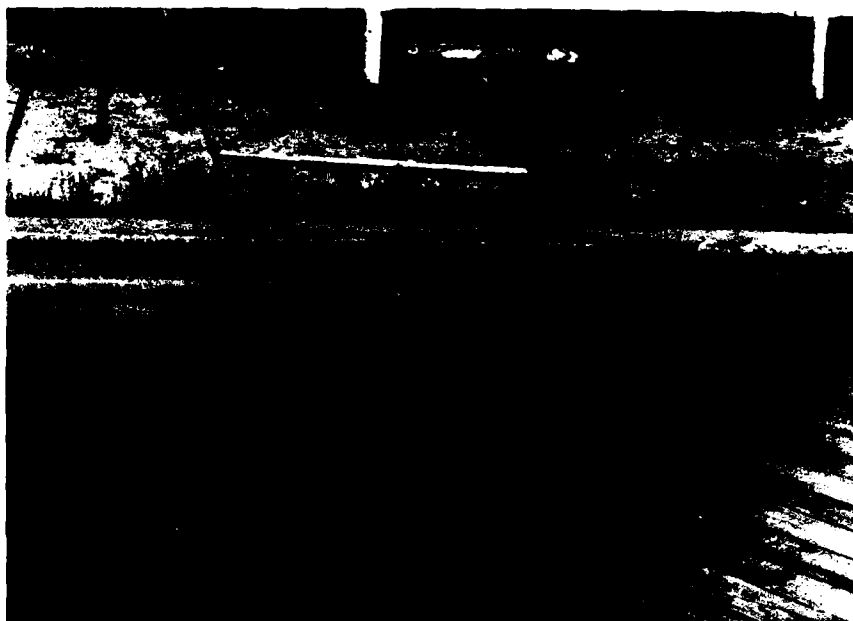
7 NOVEMBER 1979
HOUSES LOCATED JUST 100 FEET DOWNSTREAM
OF DAM.



7 NOVEMBER 1979
VIEW OF THE SUMMIT LAKE 600 FEET DOWNSTREAM
OF LAKE TAMARACK, FROM THE BRIDGE LOCATED ON
ENTRANCE TO SUMMIT LAKE. HOUSES ARE SLIGHTLY
ABOVE WATER SURFACE.



7 NOVEMBER 1979
VIEW OF CHANNEL DOWNSTREAM OF ROAD CROSSING
ABOUT 100 FEET DOWNSTREAM OF THE DAM.



7 NOVEMBER 1979
VIEW OF THE CRACK ON THE UPSTREAM FACE
OF THE DAM.

APPENDIX 3
HYDROLOGIC COMPUTATIONS

LAKE TAMARACK DAM

JOB NO. 3409-10SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

HYDROLOGIC COMPUTATIONS

NAME: LAKE TAMARACK DAM

LOCATION: SUSSEX COUNTY, N.J.

DRAINAGE AREA: 0.8 mi²

SURFACE AREA (NORMAL BOT): 34 ac.

EVALUATION CRITERIA: SIZE: SMALL

HAZARD: HIGH

SPILLWAY DESIGN FLOOD: BASED ON SIZE AND HAZARD CLASSIFICATION, THE SPILLWAY DESIGN FLOOD WILL BE THE $\frac{1}{2}$ PMF ($\frac{1}{2}$ THE PROBABLE MAXIMUM FLOOD), WITH A PEAK INFLOW OF 1295 CFS.

NOTE: DRAINAGE AREA AND SURFACE AREA OF LAKE TAMARACK DAM WERE PLANIMETERED OFF U.S.G.S QUAD SHEETS.

JOB NO. 3409-10SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

TIME OF CONCENTRATION1- SCS TR #55 METHOD:

a- OVERLAND FLOW

$$LENGTH = 4900 \text{ FT}$$

$$HEAD = 1320 - 1070 = 250 \text{ FT}$$

$$SLOPE = \frac{250 \text{ FT}}{4900 \text{ FT}} = 0.05 = 5\%$$

FROM FIGURE 3-1, PAGE 3-2, USING FOREST
AND MEADOW CURVE

$$V = 0.57 \text{ FT/sec}$$

$$T_c = \frac{4900 \text{ FT}}{0.57 \text{ FT/sec}} = 8596 \text{ Sec} = 143 \text{ Min}$$

b) CHANNEL FLOW

$$LENGTH = 2050 \text{ FT}$$

$$HEAD = 1070 - 1035 = 35 \text{ FT}$$

$$SLOPE = \frac{35}{2050} = 0.017 = 1.7\%$$

$$R = 0.83 \text{ FT}$$

(ASSUME A RECTANGULAR CHANNEL 10'x1')

USE MANNING'S EQUATION

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

JOB NO. 3409-10

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

WHERE $*n = 0.04$

$$U = \frac{1.49}{0.04} (0.83)^{2/3} - (0.017)^{1/2} = 4.3 \text{ FT/Sec}$$

$$T_c = \frac{2050 \text{ FT}}{4.3 \text{ FT/Sec}} = 477 \text{ Sec} = 8 \text{ Min}$$

$$\text{TOTAL } T_c = 143 + 8 = \underline{151 \text{ Min}}$$

2 - Soil & WATER CONSERVATION ENGINEERING METHOD:

$$L = 0.6 T_c$$

$$L = \frac{L^{0.8} (S+1)^{1.67}}{9000 Y^{0.5}}$$

$$S = \frac{1000}{CN} - 10$$

APPROXIMATELY 20% OF THE DRAINAGE AREA IS SUBURBAN.
CALCULATE COMPOSITE CN FOR DRAINAGE AREA.

<u>LAND USE</u>	<u>PCT.</u>	<u>CN</u>	<u>PRODUCT</u>
SUBURBAN	20	90	1800
WOODS (WITH SOME STORAGE AREAS)	80	55	4400
	<u>100</u>		<u>6200</u>

$$\text{COMPOSITE CN} = \frac{6200}{100} = 62$$

*"n" VALUE WAS TAKEN FROM "OPEN CHANNEL
HYDRAULICS" BY CHOW.

JOB NO. 3409-10SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

$$S = \frac{1000}{62} - 10 = 6.1$$

$$L = 4900 + 2050 = 6950 \text{ FT}$$

$$Y = \frac{5 + 1.7}{2} = 3.35 \%$$

$$L = \frac{(6950)^{0.8} (6.1 + 1)^{1.67}}{9000 (3.35)^{.5}} = 1.9 \text{ hrs}$$

$$T_c = \frac{1.9}{0.6} = 3.2 \text{ hrs} = \underline{\underline{192 \text{ min}}}$$

3- TEXAS HIGHWAY VELOCITY DATA (DESIGN OF SMALL DAMS)

a) OVERLAND FLOW:

$$\text{SLOPE} = 5 \%$$

$$\text{AVE. VELOCITY} = 1 \text{ FT/SEC}$$

($V=1 \text{ FT/SEC}$ WAS CHOSEN TO ACCOUNT FOR THE STORAGE AREAS IN THE DRAINAGE AREA).

$$T_c = \frac{4900 \text{ FT}}{1 \text{ FT/SEC}} = 4900 \text{ SEC} = 82 \text{ Min}$$

b) CHANNEL FLOW:

$$\text{SLOPE} = 1.7 \%$$

$$\text{AVE. VELOCITY} = 2 \text{ FT/SEC}$$

$$T_c = \frac{2050}{2} = 1025 \text{ SEC} = 17 \text{ min}$$

$$\text{TOTAL } T_c = 82 + 17 = \underline{\underline{99 \text{ min}}}$$

JOB NO. 3409-10

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

4- KERBY METHOD:a) OVERLAND FLOW:

$$T_c = 0.83 \left(\frac{NL}{\sqrt{S}} \right)^{0.467}$$

$$\text{WHERE } L = 4900 \text{ FT}$$

$$N = 0.80$$

$$S = 0.05$$

$$T_c = 0.83 \left(\frac{(0.8)(4900)}{\sqrt{0.05}} \right)^{0.467} = 80 \text{ Min}$$

b) CHANNEL FLOW:

$$V = \frac{1.49}{0.04} (0.83)^{2/3} (0.017)^{1/2} = 4.3 \text{ FT/sec}$$

$$T_c = \frac{2050 \text{ FT}}{4.3 \text{ FT/sec}} = 8 \text{ Min}$$

$$\text{TOTAL } T_c = 80 + 8 = 88 \text{ Min}$$

$$\text{AVE. } T_c = \frac{151 + 192 + 99 + 88}{4} = 132 \text{ Min}$$

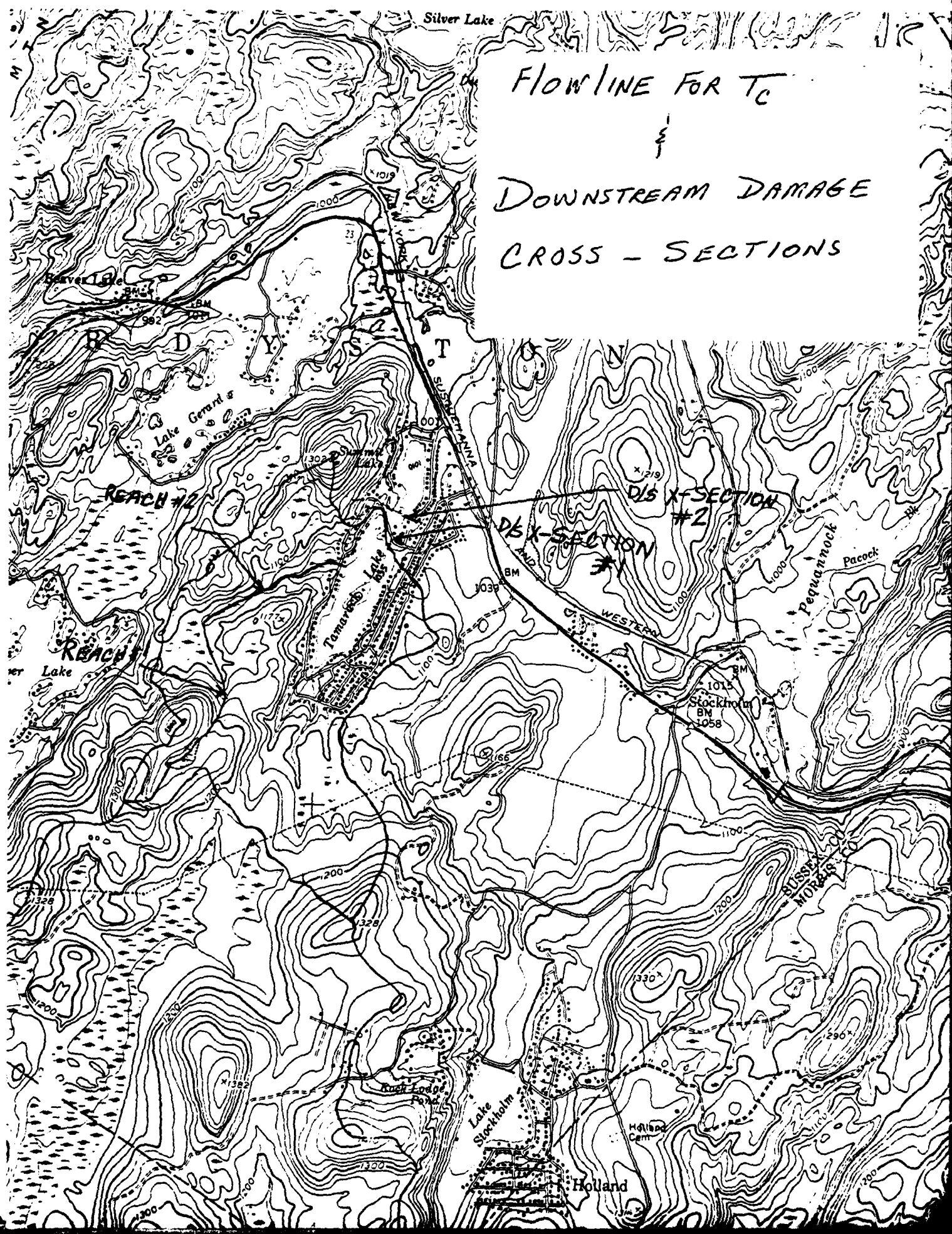
$$L = 0.6 T_c = 0.6 (132) = 79 \text{ Min}$$

$$= 1.3 \text{ hrs}$$

Silver Lake

FLOWLINE FOR T_c

DOWNSTREAM DAMAGE
CROSS - SECTIONS



JOB NO. 3409-10SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

"DEVELOPMENT OF RATING CURVE"

1 - SPILLWAY CURVE

COMPUTE Q USING WEIR EQUATION ($Q = CLH^{3/2}$)

FOR THE STOPLOG SPILLWAY ON THE DAM WITH
 $*C = 3.5$

COMPUTE Q USING "HYDRAULIC CHARTS FOR THE
SELECTION OF HIGHWAY CULVERTS" BY U. S. DEPT.
OF TRANSPORTATION, USING INLET CONTROL

2 - TOP OF DAM

USE WEIR EQUATION ($Q = CLH^{3/2}$) WITH $*C = 2.6$

* "C" VALUES WERE TAKEN FROM BRATER & KING
"HANDBOOK OF HYDRAULICS".

Anderson-Nichols & Company, Inc.

Subject LAKE TAMARACK DAM

Sheet No. _____ of _____

Date 12-26-79

Computed MMN

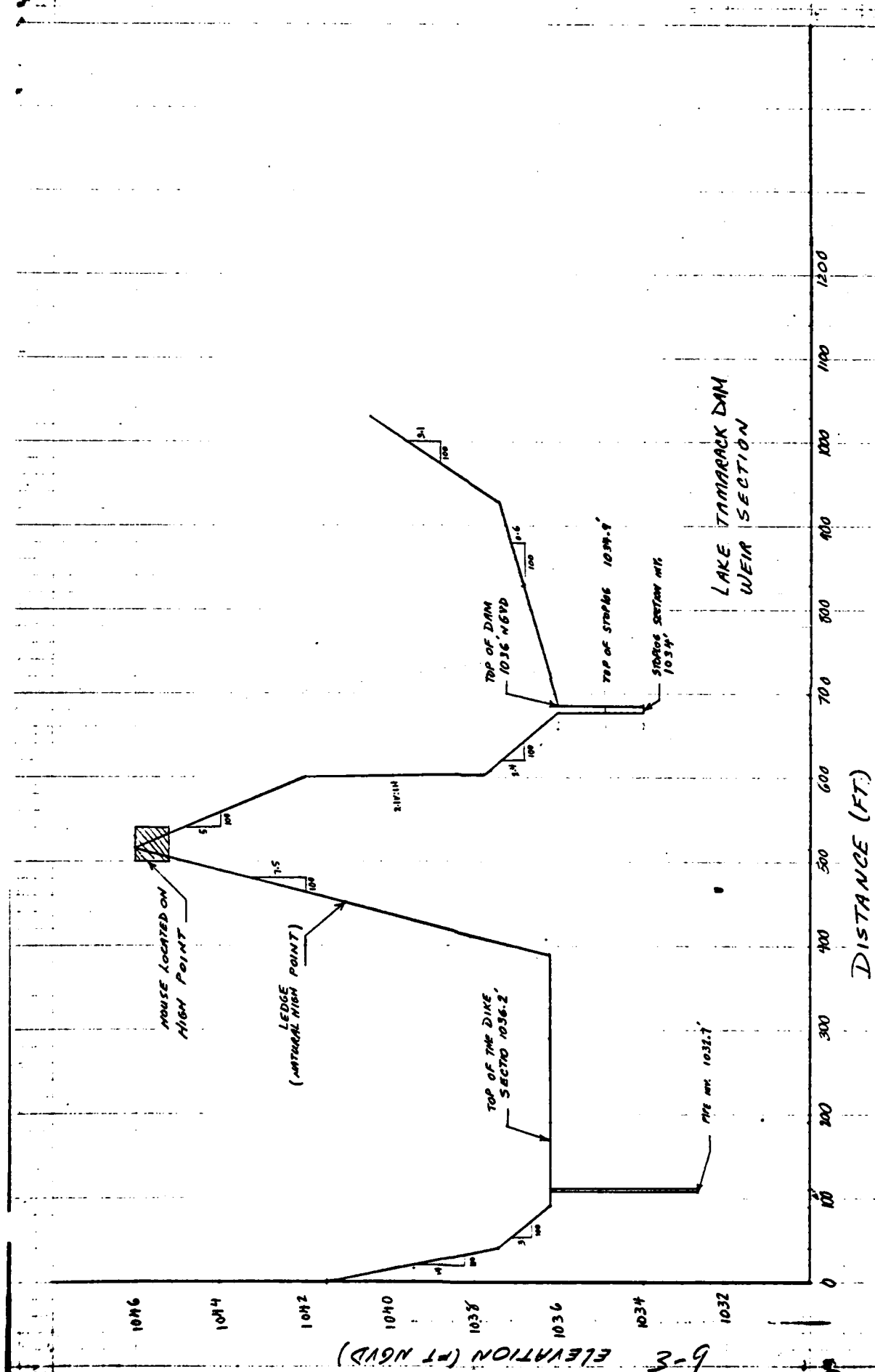
Checked _____

JOB NO. 3409-10

SQUARES
1/4 IN. SCALE

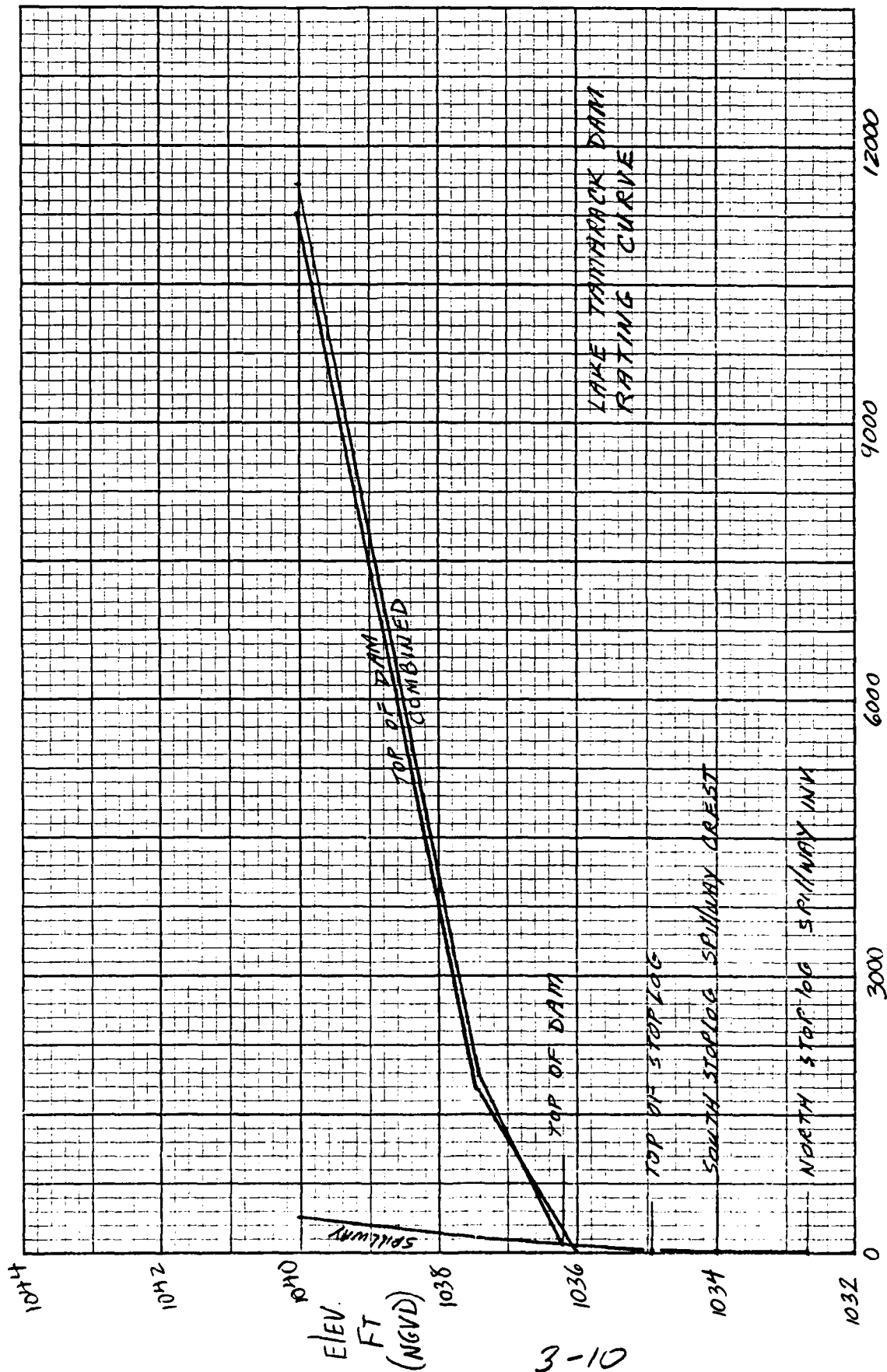
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

ELEVATION FT NGVD	SPILLWAY		TOTAL SPILLWAY		TOP OF DAM		COMBINED Q (CFS)
	PIPE HEAD FT	S.W. HEAD FT	PIPE HEAD FT	S.W. HEAD FT	HEAD (FT)	LENGTH (FT)	
1032.7			0	0	-	-	0
1034	1.3		7.8	-	-	-	8
1034.9	2.2		18.5	-	-	-	18.5
1036	3.3		31	32	-	-	63
1036.2	3.5		33	41.5	0.2	41	80
1037.4	1.9		43	111	1.02	654.5	1914
1040	7.3		57	322	3.1	809.5	11665



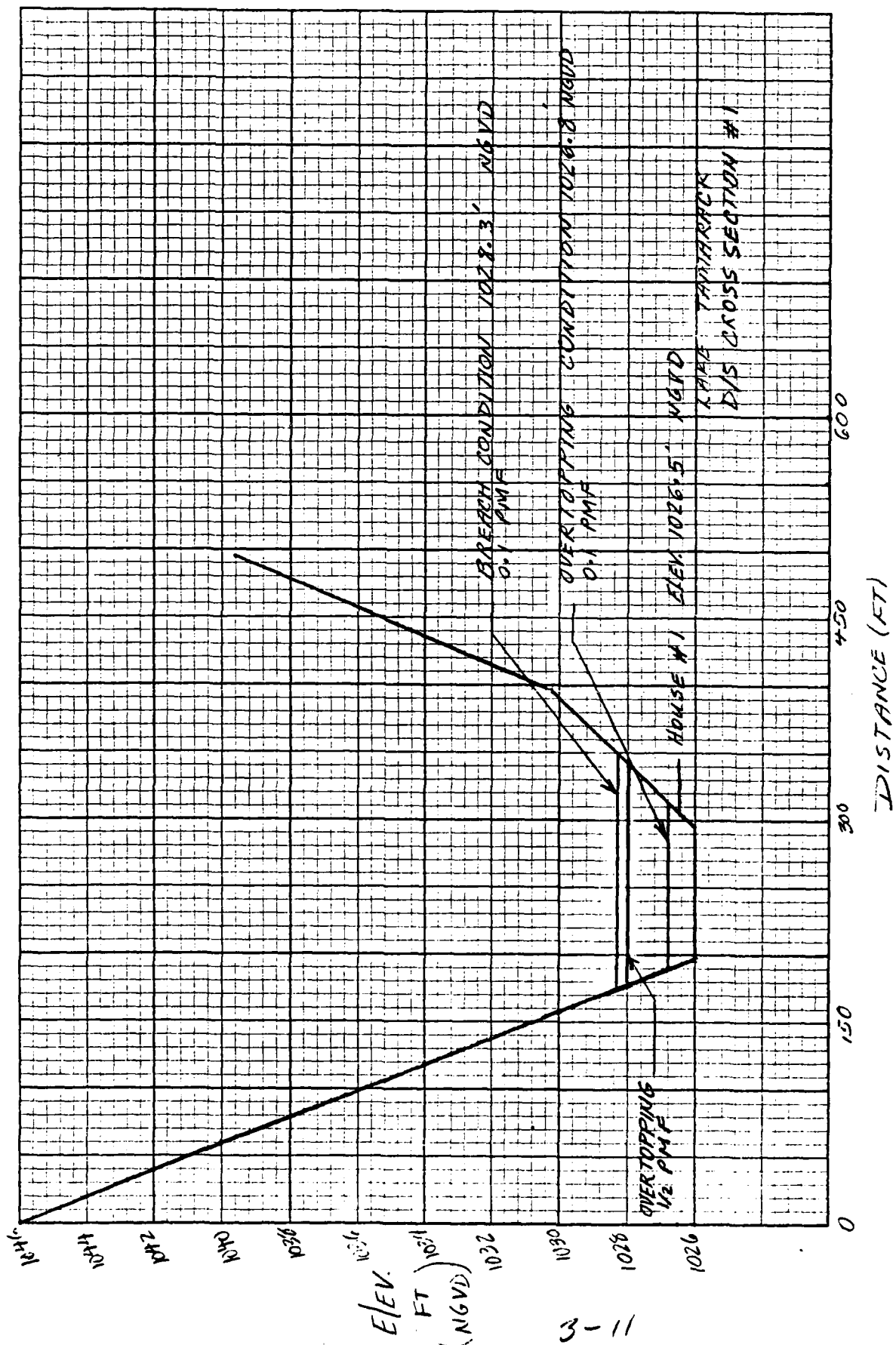
ELEVATION (FT NGVD)

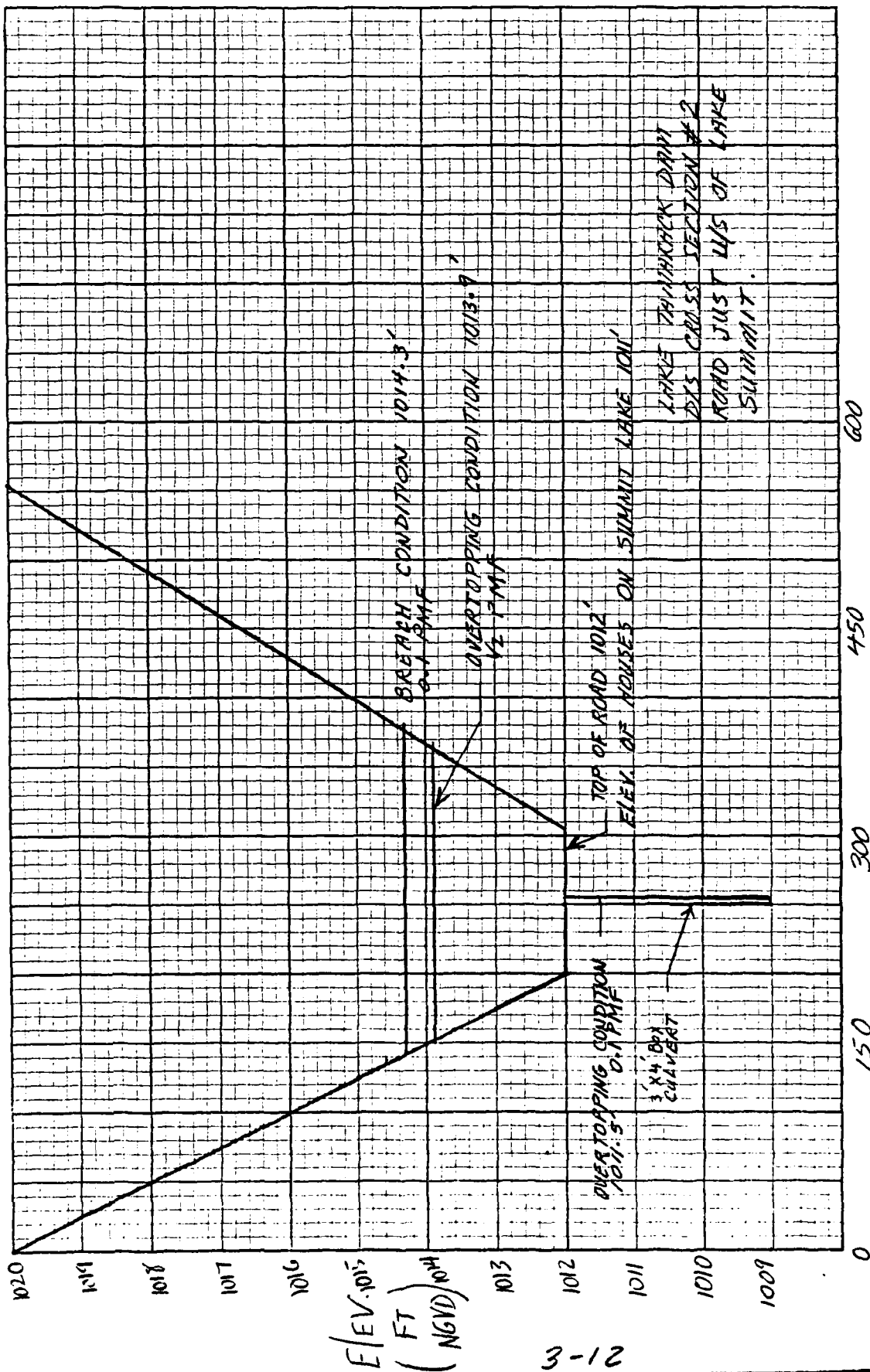
3-9



DISCHARGE (CFS)

3-10





JOB NO. 3409-10SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

ELEVATION - STORAGE DETERMINATIONASSUMPTIONS:

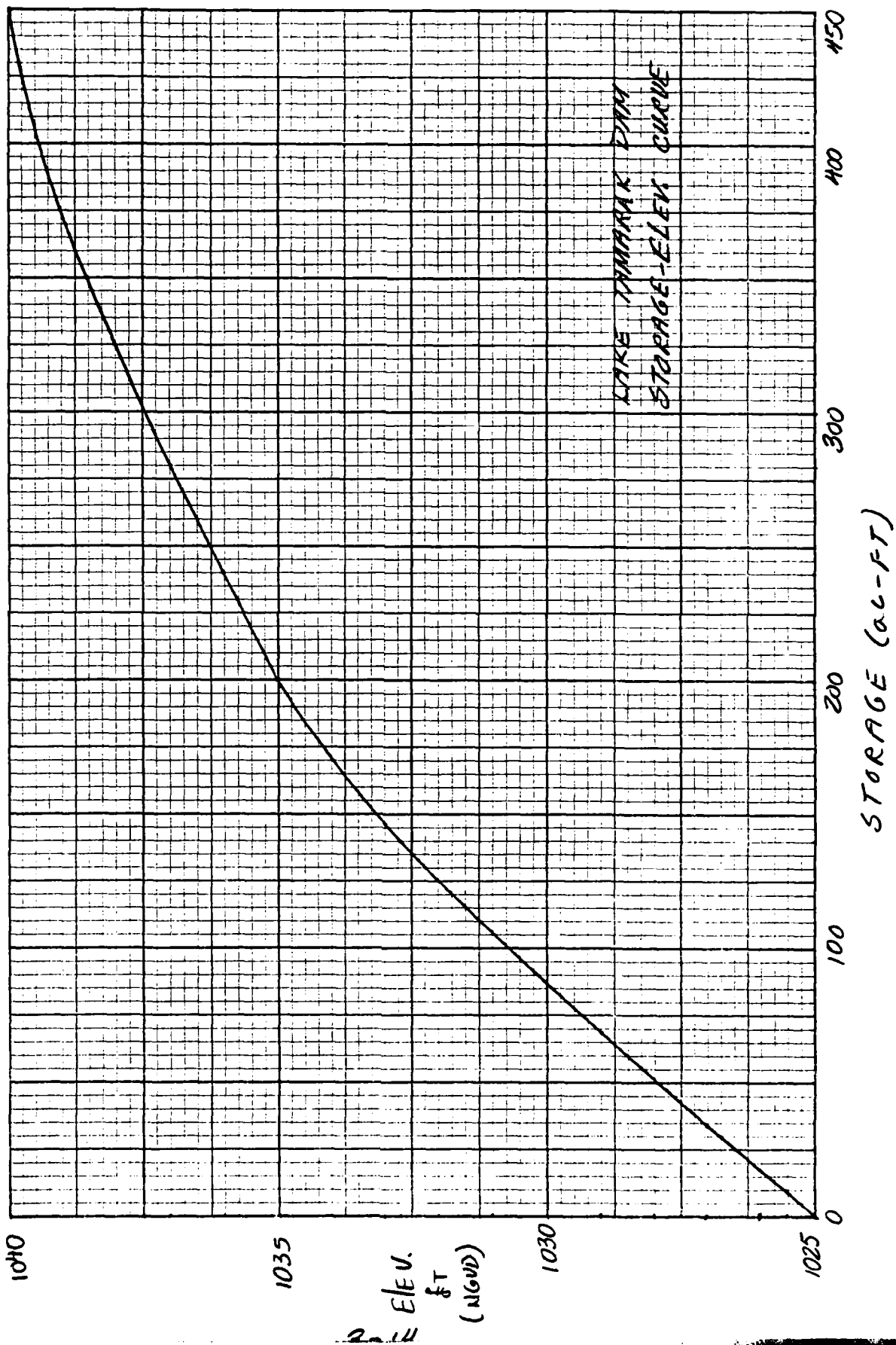
AVERAGE DEPTH = 6 FEET

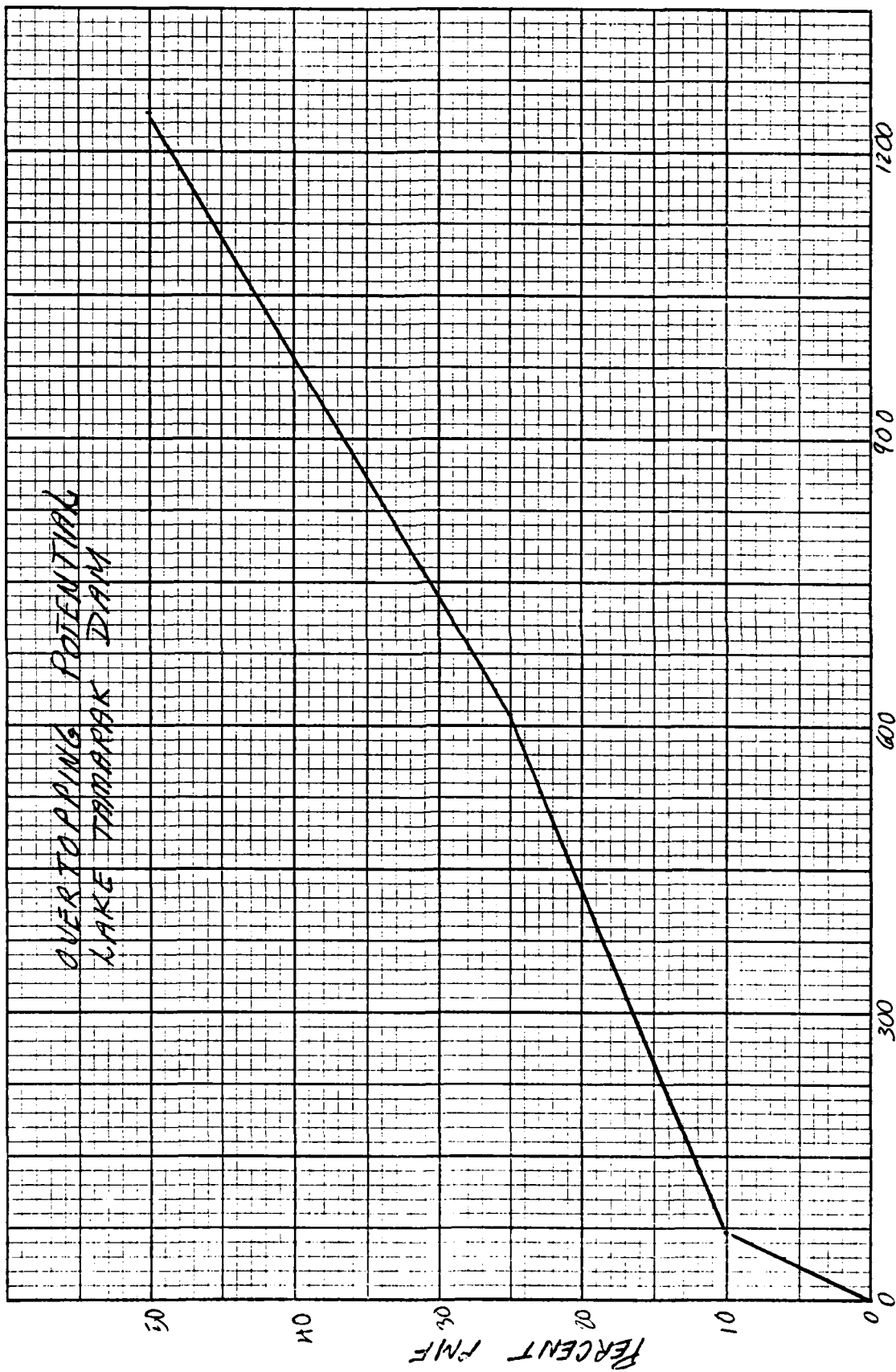
MAXIMUM DEPTH = 11 FEET

ELEVATION (FT)	SURFACE AREA (AC)	AVERAGE S. A. (AC)	INCREMENTAL STORAGE (AC-FT)	CUMULATIVE STORAGE (AC-FT)
1035	34	34	200	200
1040	66	50	250	450
1060	99	82.5	1650	2100

MEC-I INPUT:

<u>ELEV. (FT)</u>	<u>STORAGE (AC-FT)</u>
1025	0
1032.7	140
1034	170
1034.9	198
1036	240
1036.2	248
1037.4	300
1040	450





3-15

JOB NO. 3409-10

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

DETERMINATION OF "C" FOR LOW LEVEL OUTLET $D = \text{DIAMETER} = 12" \text{ CMP OR } 1.0' \text{ CMP}$ $N = 0.015 \text{ (SOIL \& WATER CONSERVATION ENGINEERING P. 632)}$ $A_p = \text{AREA OF PIPE OPENING} = 0.79 \text{ FT}^2$ $L_p = \text{LENGTH OF PIPE} = 100 \text{ FT}$ $K_f = \text{FRICTION LOSS THROUGH PIPE}$ $K_e = \text{ENTRANCE LOSS OF PIPE} = 0.8 \text{ (IBID P. 639)}$ $C_p = \text{COEFFICIENT OF DISCHARGE (INCORPORATING } A_p \text{ \& } 2g)$ $C = \text{COEFFICIENT OF DISCHARGE}$

$$K_f = \frac{5087 \text{ m}^2}{D^{4/3}} = \frac{5087 (0.015)^2}{12^{1.33}} = 0.041$$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_e + K_f L_p}} = 0.79 \sqrt{\frac{64.4}{1 + 0.8 + (0.041)(100)}}$$

$$= 2.6$$

$$C = \frac{2.6 / 0.79}{\sqrt{64.4}} = 0.41$$

JOB NO. 3409-10SQUARES
1/4 IN. SCALE

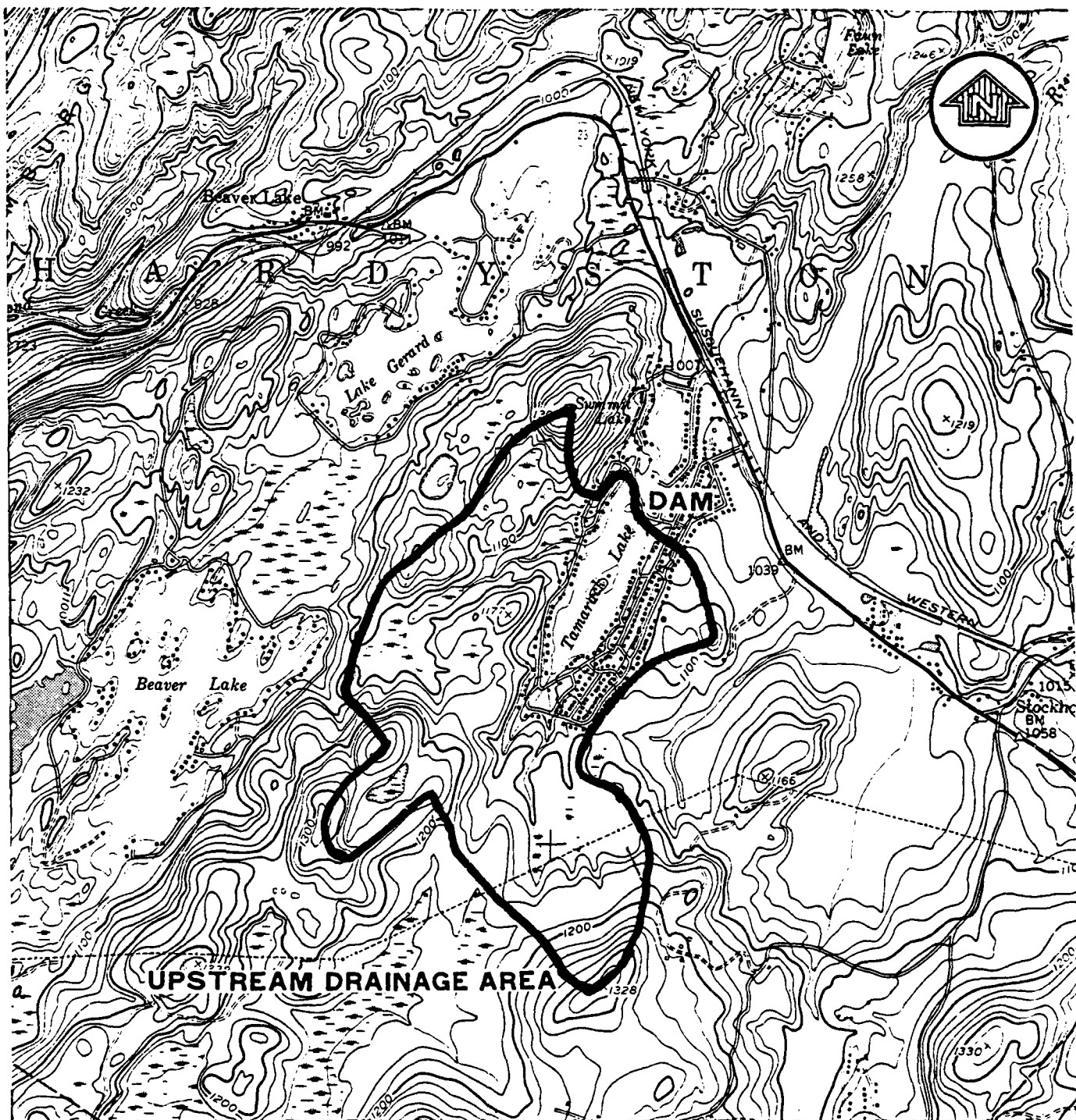
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

DRAWDOWN CALCULATIONS

CALCULATIONS ASSUME:

- 1- NO SIGNIFICANT INFLOW
- 2- LOW-LEVEL OUTLET IS OPERABLE
- 3- INV. U/S IS SAME AS INV. AT GATE
- 4- $Q_p = C_p H^{1/2} = 2.6 H^{1/2}$ (SEE PREVIOUS PAGE)
- 5- AC-FT-DAY = 1.9835 (AVE. Q)
- 6- DAYS = Δ STORAGE / AC-FT-DAY

ELEV. ft	STORAGE ac-ft	Δ STORAGE ac-ft	H ft	Q cfs	AVE Q cfs	ac ft/ DAY	DAYS
1035	200		10	8.2			
		54			7.7	15.3	3.5
1033	146		8	7.3			
		41			6.8	13.5	3
1031	105		6	6.4			
		37			5.8	11.5	3.2
1029	68		4	5.2			
		34			4.5	8.9	3.8
1027	34		2	3.8			
		34			1.9	3.8	9
1025	0		0	0			
							22.5
							DAYS



NATIONAL PROGRAM OF INSPECTION OF
NON-FED. DAMS

LAKE TAMARACK DAM

HARDYSTON TOWNSHIP, NEW JERSEY

REGIONAL VICINITY MAP

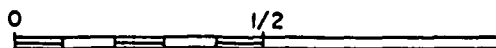
JANUARY 1980

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC.

CONCORD, N.H.

SCALE IN MILES



MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE
SHEET. FRANKLIN, N.J. 1954. REVISED 1971.

HEC-1 OUTPUT
OVERTOPPING AND BREACH ANALYSIS

LAKE TAMARACK DAM

SUPMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	1035.00	1034.90	1036.00
OUTFLOW	202.	198.	240.
	23.	19.	63.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1036.06	.06	242.	1778.	.60	19.50	19.50
.25	1036.27	.27	251.	1877.	1.04	17.00	16.00
.50	1036.26	.26	250.	1954.	1.00	15.50	14.50

PLAN 2

ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	1035.00	1034.90	1036.00
OUTFLOW	202.	198.	240.
	23.	19.	63.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1036.13	.13	245.	70.	3.00	19.50	0.00
.25	1036.55	.55	263.	610.	7.25	17.25	0.00
.50	1036.96	.96	281.	1239.	9.75	17.25	0.00

PLAN 1 STATION R1

RATIO	MAXIMUM FLOW-CFS	MAXIMUM STAGE-FT	TIME HOURS
.10	1674.	1028.3	19.50
.25	1874.	1028.4	17.00
.50	1951.	1028.4	15.50

PLAN 2 STATION R1

RATIO	MAXIMUM FLOW-CFS	MAXIMUM STAGE-FT	TIME HOURS
.10	70.	1026.8	19.50
.25	610.	1027.5	17.25
.50	1239.	1028.0	17.25

PLAN 1 STATION R2

RATIO	MAXIMUM FLOW-CFS	MAXIMUM STAGE-FT	TIME HOURS
.10	1002.	1014.3	19.50
.25	1874.	1014.5	17.00

.50 1864. 1014.5 15.50

PLAN 2 STATION R2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	70.	1011.5	19.50
.25	608.	1013.2	17.25
.50	1239.	1013.9	17.25

 FLOOD HYDROGRAPH PACKAGE (HFC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

A1 LAKE TAMARACK DAM OVERTOPPING ANALYSIS M-MIRENADI ANDERSON-NICHOLS

A2 DAM NUMBER US 60301

A3 0.1 0.25 0.5 MULTIPLES OF 24 HOURS PMP

1 140 0 15 0 0 0 0 0 0

2 5 3 1

3 0.1 0.25 0.5

4 0 0 0 1

K1 DEVELOP INFLOW HYDROGRAPH

1 1 2 0.0

2 2 111 123 133

3 1 1 0.1

4 1 1 0.1

5 1 1 0.1

6 1 1 0.1

7 1 1 0.1

8 1 1 0.1

9 1 1 0.1

10 1 1 0.1

11 1 1 0.1

12 1 1 0.1

13 1 1 0.1

14 1 1 0.1

15 1 1 0.1

16 1 1 0.1

17 1 1 0.1

18 1 1 0.1

19 1 1 0.1

20 1 1 0.1

21 1 1 0.1

22 1 1 0.1

23 1 1 0.1

24 1 1 0.1

25 1 1 0.1

26 1 1 0.1

27 1 1 0.1

28 1 1 0.1

29 1 1 0.1

30 1 1 0.1

31 1 1 0.1

32 1 1 0.1

33 1 1 0.1

34 1 1 0.1

35 1 1 0.1

36 1 1 0.1

37 1 1 0.1

38 1 1 0.1

39 1 1 0.1

40 1 1 0.1

41 1 1 0.1

42 1 1 0.1

43 1 1 0.1

44 1 1 0.1

45 1 1 0.1

46 1 1 0.1

47 1 1 0.1

48 1 1 0.1

49 1 1 0.1

50 1 1 0.1

51 1 1 0.1

52 1 1 0.1

53 1 1 0.1

54 1 1 0.1

55 1 1 0.1

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

HUNDEF HYDROGRAPH AT A1

ROUTE HYDROGRAPH TO A2

ROUTE HYDROGRAPH TO F1

ROUTE HYDROGRAPH TO F2

END OF NETWORK

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE: 08/03/03
 TIME: 19.53.07

LAKE TAMARACK L. OVERTOPPING ANALYSIS M-PIREHADI ANDRUSCH-NICHOLS
 DAM NUMBER US 00301
 0.1 0.25 0.5 MULTIPLES OF 24 HOURS PMP

JOB SPECIFICATION

NO	NHR	AMIN	IDAY	IHR	IPIN	METRC	IPLT	IPRT	INSTAN
140	0	15	0	0	0	0	0	0	0
JGPR NWT LROFT TRACE									
	5				0				0

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 2 NRATIO= 3 LRIO= 1

RTIOS= .10 .25 .50

***** ***** *****

SUR-AREA RUNOFF COMPUTATION

DEVELOP INFLOW HYDROGRAPH

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAG	IAUTO
A1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IRYNG	IRYNG	IRYNG	IRYNG	IRYNG	IRYNG	IRYNG	IRYNG	IRYNG
1	2	2	2	2	2	2	2	2

PRECIP DATA

SPFE	PFS	RC	R12	R24	R48	R72	R96
0.00	22.00	111.00	123.00	133.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .P00

LOSS DATA

IPORT	STARR	MTFR	PTIOL	FRATN	STIRS	RTIOK	STPTL	CNSTL	ALSMX	RTIMP
1	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= 1.30

PRECSSION DATA

RTICE= 1.00

UNIT HYDROGRAPH OF PERIOD OPERATES. TC= 0.00 LAG= 1.30 VOL= 1.00
 22. 101. 22. 245. 270. 247. 210. 159. 114.
 00. 00. 00. 00. 00. 00. 00. 00. 00.
 00. 00. 00. 00. 00. 00. 00. 00. 00.

END-OF-PERIOD FLOW

PC.DA	PE.PD	PERIOD	RATE	EXCS	LOSS	CRPD	PC.DA	PE.PD	PERIOD	RAIN	EXCS	LOSS	CRPD
1.01	1.15	1	.03	0.00	.03	2.	1.01	17.45	71	.54	.51	.02	2046.
1.01	1.20	2	.03	0.00	.03	2.	1.01	18.00	72	.54	.51	.02	1819.
1.01	1.25	3	.03	0.00	.03	2.	1.01	18.15	73	.04	.02	.03	1637.
1.01	1.30	4	.03	0.00	.03	2.	1.01	18.30	74	.04	.02	.03	1471.
1.01	1.35	5	.02	.09	.02	2.	1.01	18.45	75	.04	.02	.03	1293.
1.01	1.40	6	.02	0.00	.03	2.	1.01	19.00	76	.04	.02	.03	1095.
1.01	1.45	7	.03	0.00	.03	2.	1.01	19.15	77	.04	.02	.03	900.
1.01	1.50	8	.03	0.00	.03	2.	1.01	19.30	78	.04	.02	.03	718.
1.01	1.55	9	.03	0.00	.03	2.	1.01	19.45	79	.04	.02	.03	560.
1.01	1.60	10	.03	0.00	.03	2.	1.01	20.00	80	.04	.02	.03	429.
1.01	1.65	11	.03	0.00	.03	2.	1.01	20.15	81	.04	.02	.03	331.
1.01	1.70	12	.03	0.00	.03	2.	1.01	20.30	82	.04	.02	.03	259.
1.01	1.75	13	.03	0.00	.03	2.	1.01	20.45	83	.04	.02	.03	205.
1.01	1.80	14	.03	0.00	.03	2.	1.01	21.00	84	.04	.02	.03	164.
1.01	1.85	15	.03	0.00	.03	2.	1.01	21.15	85	.04	.02	.03	133.
1.01	1.90	16	.03	0.00	.03	2.	1.01	21.30	86	.04	.02	.03	111.
1.01	1.95	17	.03	0.00	.03	2.	1.01	21.45	87	.04	.02	.03	93.
1.01	2.00	18	.03	0.00	.03	2.	1.01	22.00	88	.04	.02	.03	79.
1.01	2.05	19	.03	0.00	.03	2.	1.01	22.15	89	.04	.02	.03	69.
1.01	2.10	20	.03	0.00	.03	2.	1.01	22.30	90	.04	.02	.03	60.
1.01	2.15	21	.03	0.00	.03	2.	1.01	22.45	91	.04	.02	.03	55.
1.01	2.20	22	.03	0.00	.03	2.	1.01	23.00	92	.04	.02	.03	51.
1.01	2.25	23	.03	0.00	.03	2.	1.01	23.15	93	.04	.02	.03	48.
1.01	2.30	24	.03	0.00	.03	2.	1.01	23.30	94	.04	.02	.03	46.
1.01	2.35	25	.09	0.00	.09	2.	1.01	23.45	95	.04	.02	.03	45.
1.01	2.40	26	.09	0.00	.09	2.	1.02	0.00	96	.04	.02	.03	44.
1.01	2.45	27	.09	0.00	.09	2.	1.02	.15	97	.00	0.00	0.00	42.
1.01	2.50	28	.09	.04	.05	3.	1.02	.30	98	0.00	0.00	0.00	40.
1.01	2.55	29	.09	.06	.03	7.	1.02	.45	99	0.00	0.00	0.00	37.
1.01	2.60	30	.09	.06	.03	14.	1.02	1.00	100	0.00	0.00	0.00	33.
1.01	2.65	31	.09	.06	.03	26.	1.02	1.15	101	0.00	0.00	0.00	28.
1.01	2.70	32	.09	.06	.03	42.	1.02	1.30	102	0.00	0.00	0.00	23.
1.01	2.75	33	.09	.06	.03	58.	1.02	1.45	103	0.00	0.00	0.00	18.
1.01	2.80	34	.09	.06	.03	75.	1.02	2.00	104	0.00	0.00	0.00	14.
1.01	2.85	35	.09	.06	.03	89.	1.02	2.15	105	0.00	0.00	0.00	11.
1.01	2.90	36	.09	.06	.03	100.	1.02	2.30	106	0.00	0.00	0.00	9.
1.01	2.95	37	.09	.06	.03	108.	1.02	2.45	107	0.00	0.00	0.00	7.
1.01	3.00	38	.09	.06	.03	114.	1.02	3.00	108	0.00	0.00	0.00	6.
1.01	3.05	39	.09	.06	.03	119.	1.02	3.15	109	0.00	0.00	0.00	5.
1.01	3.10	40	.09	.06	.03	122.	1.02	3.30	110	0.00	0.00	0.00	4.
1.01	3.15	41	.09	.06	.03	125.	1.02	3.45	111	0.00	0.00	0.00	4.
1.01	3.20	42	.09	.06	.03	127.	1.02	4.00	112	0.00	0.00	0.00	4.
1.01	3.25	43	.09	.06	.03	128.	1.02	4.15	113	0.00	0.00	0.00	3.
1.01	3.30	44	.09	.06	.03	129.	1.02	4.30	114	0.00	0.00	0.00	3.
1.01	3.35	45	.09	.06	.03	130.	1.02	4.45	115	0.00	0.00	0.00	3.
1.01	3.40	46	.09	.06	.03	131.	1.02	5.00	116	0.00	0.00	0.00	3.
1.01	3.45	47	.09	.06	.03	131.	1.02	5.15	117	0.00	0.00	0.00	3.
1.01	3.50	48	.09	.06	.03	132.	1.02	5.30	118	0.00	0.00	0.00	3.
1.01	3.55	49	.09	.06	.03	141.	1.02	5.45	119	0.00	0.00	0.00	3.
1.01	3.60	50	.09	.06	.03	140.	1.02	6.00	120	0.00	0.00	0.00	2.
1.01	3.65	51	.09	.06	.03	225.	1.02	6.15	121	0.00	0.00	0.00	2.
1.01	3.70	52	.09	.06	.03	314.	1.02	6.30	122	0.00	0.00	0.00	2.
1.01	3.75	53	.09	.06	.03	422.	1.02	6.45	123	0.00	0.00	0.00	2.
1.01	3.80	54	.09	.06	.03	537.	1.02	7.00	124	0.00	0.00	0.00	2.
1.01	3.85	55	.09	.06	.03	749.	1.02	7.15	125	0.00	0.00	0.00	2.
1.01	3.90	56	.09	.06	.03	755.	1.02	7.30	126	0.00	0.00	0.00	2.

1.01	19.15	.57	.73	.71	.02	.048.	1.02	7.45	127	0.00	0.00	2.
1.01	19.30	.58	.73	.71	.02	.930.	1.02	0.00	128	0.00	0.00	2.
1.01	19.45	.59	.73	.71	.02	1002.	1.02	8.15	129	0.00	0.00	2.
1.01	19.60	.60	.73	.71	.02	1088.	1.02	8.30	130	0.00	0.00	2.
1.01	19.75	.61	.74	.72	.02	1163.	1.02	0.45	131	0.00	0.00	2.
1.01	19.90	.62	1.48	1.46	.02	1245.	1.02	9.00	132	0.00	0.00	2.
1.01	19.45	.63	4.16	4.13	.03	1413.	1.02	9.15	133	0.00	0.00	2.
1.01	19.00	.64	1.04	1.01	.02	1677.	1.02	9.30	134	0.00	0.00	2.
1.01	18.15	.65	.68	.66	.02	2036.	1.02	9.45	135	0.00	0.00	2.
1.01	18.30	.66	.68	.66	.02	2591.	1.02	10.00	136	0.00	0.00	2.
1.01	18.45	.67	.68	.66	.02	2575.	1.02	10.15	137	0.00	0.00	2.
1.01	18.00	.68	.68	.66	.02	2591.	1.02	10.30	138	0.00	0.00	2.
1.01	17.15	.69	.54	.51	.02	2481.	1.02	10.45	139	0.00	0.00	2.
1.01	17.30	.70	.54	.51	.02	2295.	1.02	11.00	140	0.00	0.00	2.

SUP 23.41 120.69 2.72 43026.
(595.11 526.11 69.01 1216.36)

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
2591.	1503.	447.	307.	43042.
734	43.	134	94	1219.
INCHES	17.48	20.80	20.85	20.85
PM	444.02	528.41	529.68	529.68
AC-F1	735.	887.	889.	889.
THOUS CU M	920.	1094.	1097.	1097.

[illegible]

1

1

100

100

1

1

12-13

Age Group	1980	1990	2000
15-24	25	20	15
25-34	15	18	20
35-44	10	12	15
45-54	5	8	10
55-64	2	4	5
65+	1	2	2

1

1

1

1

Abstract

2

10

10

[illegible]

•CVN•

STATION A2, PLAN 1, RATIO 3

BEGIN DAM FAILURE AT 14.50 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

22.	22.	21.	21.	20.	20.	19.	19.	18.
18.	18.	18.	18.	18.	18.	17.	17.	17.
17.	17.	17.	17.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	17.	17.	18.	18.
18.	18.	19.	20.	21.	22.	23.	25.	26.
28.	30.	33.	38.	44.	50.	58.	68.	737.
1277.	1954.	1710.	1522.	1402.	1332.	1306.	1277.	1273.
1230.	1171.	1104.	1029.	951.	863.	780.	621.	548.
483.	429.	374.	331.	293.	261.	234.	199.	171.
155.	142.	130.	120.	110.	102.	95.	89.	78.
73.	68.	64.	60.	56.	52.	49.	46.	41.
34.	36.	34.	32.	30.	29.	27.	26.	23.
23.	21.	20.	19.	18.	18.	17.	16.	15.
19.	14.	13.	13.	12.	12.	11.	11.	10.

STORAGE

201.	201.	201.	200.	199.	199.	199.	198.	198.
198.	197.	197.	196.	196.	196.	195.	195.	195.
194.	194.	194.	193.	193.	193.	192.	192.	192.
191.	191.	192.	193.	193.	194.	195.	195.	196.
197.	198.	199.	200.	201.	203.	204.	205.	205.
207.	209.	212.	216.	223.	228.	235.	243.	249.
241.	220.	196.	179.	166.	162.	161.	160.	158.
153.	149.	144.	138.	134.	125.	119.	112.	98.
912.	857.	775.	74.	64.	60.	56.	51.	50.
47.	48.	42.	40.	37.	36.	34.	31.	31.
304.	292.	277.	263.	244.	231.	223.	214.	214.
20.	19.	18.	18.	17.	16.	16.	15.	15.
14.	14.	13.	13.	12.	12.	12.	11.	11.
11.	10.	10.	10.	9.	9.	9.	9.	9.

1035.8	1035.0	1035.0	1035.0	1034.9	1034.9	1034.9	1034.9	1034.9
1034.9	1034.9	1034.9	1034.9	1034.8	1034.8	1034.8	1034.8	1034.8
1034.8	1034.8	1034.8	1034.7	1034.7	1034.7	1034.7	1034.7	1034.7
1034.7	1034.7	1034.7	1034.7	1034.7	1034.7	1034.8	1034.8	1034.8
1034.9	1034.9	1034.9	1034.9	1035.0	1035.0	1035.0	1035.1	1035.1
1035.1	1035.2	1035.3	1035.4	1035.5	1035.7	1035.9	1036.1	1036.2
1036.0	1035.5	1034.8	1034.3	1033.9	1033.7	1033.6	1033.6	1033.5
1035.3	1035.1	1032.9	1032.6	1032.2	1031.9	1031.5	1031.1	1030.4
1030.0	1029.7	1029.3	1029.0	1028.8	1028.5	1028.3	1027.9	1027.8
1027.6	1027.5	1027.3	1027.2	1027.1	1027.0	1026.9	1026.8	1026.7
1026.6	1026.6	1026.5	1026.4	1026.4	1026.3	1026.3	1026.2	1026.1
1026.1	1026.1	1026.0	1026.0	1025.9	1025.9	1025.9	1025.8	1025.8
1025.8	1025.8	1025.7	1025.7	1025.7	1025.7	1025.7	1025.6	1025.6
1025.6	1025.6	1025.6	1025.5	1025.5	1025.5	1025.5	1025.5	1025.5

PEAK OUTFLOW IS 1950. AT TIME 15.50 HOURS

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

	1954.	1957.	315.	221.	30935.
CPS	55.	30.	%	6.	876.
INCHES		12.29	14.64	14.99	14.99
PM		312.20	371.90	380.69	380.69
AC-FT		524.	624.	639.	639.
THOUS CU M		647.	770.	788.	788.

THE DAF IF EACD HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION. DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .250 HOURS. THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH. INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	COMPUTED BREACH HYDROGRAPH (CFS)	ERRCP (CFS)	ACCUMULATED ERRCP (CFS)	ACCUMULATED ERRCP (AC-FT)
14.500	0.000	68.	74.	0.	0.	0.
14.521	.021	90.	74.	16.	16.	0.
14.542	.042	111.	73.	29.	44.	0.
14.563	.063	133.	94.	39.	83.	0.
14.583	.083	155.	107.	48.	131.	0.
14.604	.104	177.	122.	54.	185.	0.
14.625	.125	199.	139.	59.	245.	0.
14.646	.146	220.	158.	62.	307.	1.
14.667	.167	242.	178.	64.	371.	1.
14.688	.188	264.	216.	48.	419.	1.
14.708	.208	286.	254.	32.	451.	1.
14.729	.229	307.	292.	15.	466.	1.
14.750	.250	329.	329.	0.	466.	1.
14.771	.271	363.	366.	-3.	464.	1.
14.792	.292	397.	402.	-5.	459.	1.
14.813	.313	431.	438.	-7.	452.	1.
14.833	.333	465.	473.	-8.	445.	1.
14.854	.354	499.	507.	-8.	436.	1.
14.875	.375	533.	541.	-8.	428.	1.
14.896	.396	567.	575.	-8.	420.	1.
14.917	.417	601.	608.	-7.	412.	1.
14.938	.438	635.	641.	-6.	406.	1.
14.958	.458	669.	673.	-4.	402.	1.
14.979	.479	703.	705.	-2.	399.	1.
15.000	.500	737.	737.	0.	399.	1.
15.021	.521	782.	768.	14.	413.	1.
15.042	.542	827.	798.	28.	441.	1.
15.063	.563	872.	829.	43.	484.	1.
15.083	.583	917.	871.	46.	530.	1.
15.104	.604	962.	919.	43.	572.	1.
15.125	.625	1007.	967.	39.	612.	1.
15.146	.646	1052.	1017.	35.	647.	1.
15.167	.667	1097.	1067.	29.	676.	1.
15.188	.688	1142.	1118.	23.	699.	1.
15.208	.708	1187.	1170.	16.	715.	1.
15.229	.729	1232.	1223.	8.	724.	1.
15.250	.750	1277.	1277.	0.	724.	1.
15.271	.771	1333.	1331.	2.	726.	1.
15.292	.792	1390.	1385.	4.	730.	1.
15.313	.812	1446.	1441.	5.	735.	1.
15.333	.833	1502.	1497.	6.	741.	1.
15.354	.854	1559.	1553.	6.	747.	1.
15.375	.875	1615.	1600.	6.	754.	1.
15.396	.896	1672.	1666.	6.	759.	1.
15.417	.917	1728.	1724.	5.	764.	1.
15.438	.937	1785.	1781.	4.	769.	1.
15.458	.958	1841.	1830.	3.	771.	1.
15.479	.979	1898.	1894.	1.	772.	1.
15.500	1.000	1954.	1954.	0.	772.	1.

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLICK

STORAGE

Stack

HYDROGRAPH ROUTING

ROUTE OUTFLOW HYDROGRAPH THROUGH REACH ONE

ISTAO	ICOMP	IECON	IIAPE	IIPL	IPRI	INAME	ISTAGE	IAUTO
R1	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME

ROUTING DATA		ROUTING DATA	
CLS	AVG	CLS	AVG
0.0	0.000	0.0	0.000
0.0	0.000	0.0	0.000

NSIPS	NSTOL	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL WITH CHANNEL ROUTING

ON(1)	ON(2)	ON(1)	ELNVT	ELMAX	RLNTH	SEL
0.000	0.000	0.000	1026.0	1040.0	50.	0.02500

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

STA	ELEV	STA	ELEV
0.00	1046.00	40.00	1042.00
295.00	1026.50	395.00	1030.20

STORAGE	0.00	1.70	1.90	2.23	2.52	2.82	3.14	3.46	3.80	4.15	4.52
0.00	54.04	591.60	591.60	591.60	591.60	591.60	591.60	591.60	591.60	591.60	591.60

OUTFLOW	0.00	20220.89	24598.43	29411.21	34671.60	40305.40	4744.97	6903.30	9666.07	12764.85	16282.66
0.00	20220.89	24598.43	29411.21	34671.60	40305.40	4744.97	6903.30	9666.07	12764.85	16282.66	76382.77

STATION 1, PLAN 1, RTIO 3

[illegible]

STABLE

[illegible]

[illegible]

[illegible]

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
1	1.0	1.0	1.0	3.0
2	1.0	1.0	1.0	3.0
3	1.0	1.0	1.0	3.0
4	1.0	1.0	1.0	3.0
5	1.0	1.0	1.0	3.0
6	1.0	1.0	1.0	3.0
7	1.0	1.0	1.0	3.0
8	1.0	1.0	1.0	3.0
9	1.0	1.0	1.0	3.0
10	1.0	1.0	1.0	3.0
11	1.0	1.0	1.0	3.0
12	1.0	1.0	1.0	3.0
13	1.0	1.0	1.0	3.0
14	1.0	1.0	1.0	3.0
15	1.0	1.0	1.0	3.0
16	1.0	1.0	1.0	3.0
17	1.0	1.0	1.0	3.0
18	1.0	1.0	1.0	3.0
19	1.0	1.0	1.0	3.0
20	1.0	1.0	1.0	3.0
21	1.0	1.0	1.0	3.0
22	1.0	1.0	1.0	3.0
23	1.0	1.0	1.0	3.0
24	1.0	1.0	1.0	3.0
25	1.0	1.0	1.0	3.0
26	1.0	1.0	1.0	3.0
27	1.0	1.0	1.0	3.0
28	1.0	1.0	1.0	3.0
29	1.0	1.0	1.0	3.0
30	1.0	1.0	1.0	3.0
31	1.0	1.0	1.0	3.0
32	1.0	1.0	1.0	3.0
33	1.0	1.0	1.0	3.0
34	1.0	1.0	1.0	3.0
35	1.0	1.0	1.0	3.0
36	1.0	1.0	1.0	3.0
37	1.0	1.0	1.0	3.0
38	1.0	1.0	1.0	3.0
39	1.0	1.0	1.0	3.0
40	1.0	1.0	1.0	3.0
41	1.0	1.0	1.0	3.0
42	1.0	1.0	1.0	3.0
43	1.0	1.0	1.0	3.0
44	1.0	1.0	1.0	3.0
45	1.0	1.0	1.0	3.0
46	1.0	1.0	1.0	3.0
47	1.0	1.0	1.0	3.0
48	1.0	1.0	1.0	3.0
49	1.0	1.0	1.0	3.0
50	1.0	1.0	1.0	3.0
51	1.0	1.0	1.0	3.0
52	1.0	1.0	1.0	3.0
53	1.0	1.0	1.0	3.0
54	1.0	1.0	1.0	3.0
55	1.0	1.0	1.0	3.0
56	1.0	1.0	1.0	3.0
57	1.0	1.0	1.0	3.0
58	1.0	1.0	1.0	3.0
59	1.0	1.0	1.0	3.0
60	1.0	1.0	1.0	3.0
61	1.0	1.0	1.0	3.0
62	1.0	1.0	1.0	3.0
63	1.0	1.0	1.0	3.0
64	1.0	1.0	1.0	3.0
65	1.0	1.0	1.0	3.0
66	1.0	1.0	1.0	3.0
67	1.0	1.0	1.0	3.0
68	1.0	1.0	1.0	3.0
69	1.0	1.0	1.0	3.0
70	1.0	1.0	1.0	3.0
71	1.0	1.0	1.0	3.0
72	1.0	1.0	1.0	3.0
73	1.0	1.0	1.0	3.0
74	1.0	1.0	1.0	3.0
75	1.0	1.0	1.0	3.0
76	1.0	1.0	1.0	3.0
77	1.0	1.0	1.0	3.0
78	1.0	1.0	1.0	3.0
79	1.0	1.0	1.0	3.0
80				

239.	712.	215.	153.	21381.
------	------	------	------	--------

35.	20.	6.	4.	605.
-----	-----	----	----	------

Time	Temperature	Humidity	Wind Speed	Wind Direction	Cloud Cover	Visibility	Pressure	Notes
8:27	9.99	10.36						
10:15	9.99	10.36						
12:10	9.99	10.36						
14:10	9.99	10.36						
16:10	9.99	10.36						
18:10	9.99	10.36						
20:10	9.99	10.36						
22:10	9.99	10.36						
24:10	9.99	10.36						
26:10	9.99	10.36						
28:10	9.99	10.36						
30:10	9.99	10.36						
32:10	9.99	10.36						
34:10	9.99	10.36						
36:10	9.99	10.36						
38:10	9.99	10.36						
40:10	9.99	10.36						
42:10	9.99	10.36						
44:10	9.99	10.36						
46:10	9.99	10.36						
48:10	9.99	10.36						
50:10	9.99	10.36						
52:10	9.99	10.36						
54:10	9.99	10.36						
56:10	9.99	10.36						
58:10	9.99	10.36						
60:10	9.99	10.36						
62:10	9.99	10.36						
64:10	9.99	10.36						
66:10	9.99	10.36						
68:10	9.99	10.36						
70:10	9.99	10.36						
72:10	9.99	10.36						
74:10	9.99	10.36						
76:10	9.99	10.36						
78:10	9.99	10.36						
80:10	9.99	10.36						
82:10	9.99	10.36						
84:10	9.99	10.36						
86:10	9.99	10.36						
88:10	9.99	10.36						
90:10	9.99	10.36						
92:10	9.99	10.36						
94:10	9.99	10.36						
96:10	9.99	10.36						
98:10	9.99	10.36						
100:10	9.99	10.36						

210.15	253.68	263.12	263.12
--------	--------	--------	--------

442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
12

435 525 545

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 1028.0

HYDROGRAPH ROUTING

ROUTE OUTFLOW HYDROGRAPH THROUGH REACH TWO

ISTAQ	ICOMP	IECON	ITAPE	JFLT	JPRT	INAME	ISTAGE	IAUTC
R2	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME

ROUTING DATA

ROUTING DATA
ES ISAF

100

—

AC
ARSKY

AC: AFSSK
II: 0.50

11. 2006

10
 11
 12
 13
 14
 15
 16
 17
 18
 19
 20
 21
 22
 23
 24
 25
 26
 27
 28
 29
 30
 31
 32
 33
 34
 35
 36
 37
 38
 39
 40
 41
 42
 43
 44
 45
 46
 47
 48
 49
 50
 51
 52
 53
 54
 55
 56
 57
 58
 59
 60
 61
 62
 63
 64
 65
 66
 67
 68
 69
 70
 71
 72
 73
 74
 75
 76
 77
 78
 79
 80
 81
 82
 83
 84
 85
 86
 87
 88
 89
 90
 91
 92
 93
 94
 95
 96
 97
 98
 99
 100
 101
 102
 103
 104
 105
 106
 107
 108
 109
 110
 111
 112
 113
 114
 115
 116
 117
 118
 119
 120
 121
 122
 123
 124
 125
 126
 127
 128
 129
 130
 131
 132
 133
 134
 135
 136
 137
 138
 139
 140
 141
 142
 143
 144
 145
 146
 147
 148
 149
 150
 151
 152
 153
 154
 155
 156
 157
 158
 159
 160
 161
 162
 163
 164
 165
 166
 167
 168
 169
 170
 171
 172
 173
 174
 175
 176
 177
 178
 179
 180
 181
 182
 183
 184
 185
 186
 187
 188
 189
 190
 191
 192
 193
 194
 195
 196
 197
 198
 199
 200
 201
 202
 203
 204
 205
 206
 207
 208
 209
 210
 211
 212
 213
 214
 215
 216
 217
 218
 219
 220
 221
 222
 223
 224
 225
 226
 227
 228
 229
 230
 231
 232
 233
 234
 235
 236
 237
 238
 239
 240
 241
 242
 243
 244
 245
 246
 247
 248
 249
 250
 251
 252
 253
 254
 255
 256
 257
 258
 259
 260
 261
 262
 263
 264
 265
 266
 267
 268
 269
 270
 271
 272
 273
 274
 275
 276
 277
 278
 279
 280
 281
 282
 283
 284
 285
 286
 287
 288
 289
 290
 291
 292
 293
 294
 295
 296
 297
 298
 299
 300
 301
 302
 303
 304
 305
 306
 307
 308
 309
 310
 311
 312
 313
 314
 315
 316
 317
 318
 319
 320
 321
 322
 323
 324
 325
 326
 327
 328
 329
 330
 331
 332
 333
 334
 335
 336
 337
 338
 339
 340
 341
 342
 343
 344
 345
 346
 347
 348
 349
 350
 351
 352
 353
 354
 355
 356
 357
 358
 359
 360
 361
 362
 363
 364
 365
 366
 367
 368
 369
 370
 371
 372
 373
 374
 375
 376
 377
 378
 379
 380
 381
 382
 383
 384
 385
 386
 387
 388
 389
 390
 391
 392
 393
 394
 395
 396
 397
 398
 399
 400
 401
 402
 403
 404
 405
 406
 407
 408
 409
 410
 411
 412
 413
 414
 415
 416
 417
 418
 419
 420
 421
 422
 423
 424
 425
 426
 427
 428
 429
 430
 431
 432
 433
 434
 435
 436
 437
 438
 439
 440
 441
 442
 443
 444
 445
 446
 447
 448
 449
 450
 451
 452
 453
 454
 455
 456
 457
 458
 459
 460
 461
 462
 463
 464
 465
 466
 467
 468
 469
 470
 471
 472
 473
 474
 475
 476
 477
 478
 479
 480
 481
 482
 483
 484
 485
 486
 487
 488
 489
 490
 491
 492
 493
 494
 495
 496
 497
 498
 499
 500
 501
 502
 503
 504
 505
 506
 507
 508
 509
 510
 511
 512
 513
 514
 515
 516
 517
 518
 519
 520
 521
 522
 523
 524
 525
 526
 527
 528
 529
 530
 531
 532

NORMAL DEPTH CHANNEL ROUTING.

AD-A067 634

NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/6 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE TAMARACK DAM (NJ00301) HUDSON--ETC(U)
FEB 80 W A GUINAN DACW61-79-C-0011

UNCLASSIFIED

ML

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

2 x 2

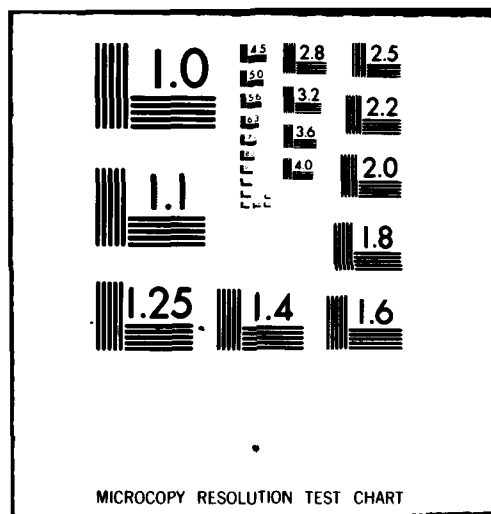
2 x 2

2 x 2

2 x 2

2 x 2

2 x 2



ON(1) ON(2) ON(3) ILMV ELMAX RLNTH SFL
 .1878 .0400 .1000 1000.0 1020.0 600. 003200

CROSS SECTION COORDINATES--STA.ELEV.STA.ELEV--ETC

0.00 1020.00 200.00 1012.00 250.00 1009.00 250.00 1007.00 250.00 1002.00
 250.00 1012.00 300.00 1012.00 350.00 1020.00

STORAGE 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 5.56 7.75 10.25 13.00 16.10 19.61 23.35 27.40 31.75 36.42

OUTFLOW 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 1623.65 2500.46 3749.25 5177.20 6807.40 8698.32 11227.82 13893.60 16912.84 20302.35

STAGE 1000.00 1000.63 1009.26 1009.69 1010.53 1011.46 1011.79 1012.42 1013.05 1013.68
 1014.32 1014.95 1015.58 1016.21 1016.84 1017.47 1018.11 1018.74 1019.37 1020.00

FLOW 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
 1623.65 2500.46 3749.25 5177.20 6807.40 8698.32 11227.82 13893.60 16912.84 20302.35

R2, PLAN 2, RTIO 3

STATION

OUTFLOW

22.	23.	21.	21.	20.	20.	19.	18.
18.	18.	18.	18.	18.	18.	17.	17.
17.	17.	17.	17.	17.	16.	16.	16.
16.	16.	16.	16.	17.	17.	17.	18.
17.	18.	19.	20.	21.	22.	24.	26.
20.	30.	33.	37.	43.	49.	66.	105.
456.	528.	557.	578.	597.	622.	1200.	1222.
1159.	1064.	964.	873.	782.	692.	503.	334.
267.	285.	164.	132.	104.	82.	70.	72.

19. 70. 67. 67. 65. 64. 63. 62. 61. 61.
 20. 71. 68. 68. 66. 65. 64. 63. 62. 61.
 21. 72. 69. 69. 67. 66. 65. 64. 63. 62.
 22. 73. 70. 70. 68. 67. 66. 65. 64. 63.
 23. 74. 71. 71. 69. 68. 67. 66. 65. 64.
 24. 75. 72. 72. 70. 69. 68. 67. 66. 65.
 25. 76. 73. 73. 71. 70. 69. 68. 67. 66.
 26. 77. 74. 74. 72. 71. 70. 69. 68. 67.
 27. 78. 75. 75. 73. 72. 71. 70. 69. 68.
 28. 79. 76. 76. 74. 73. 72. 71. 70. 69.
 29. 80. 77. 77. 75. 74. 73. 72. 71. 70.
 30. 81. 78. 78. 76. 75. 74. 73. 72. 71.
 31. 82. 79. 79. 77. 76. 75. 74. 73. 72.
 32. 83. 80. 80. 78. 77. 76. 75. 74. 73.
 33. 84. 81. 81. 79. 78. 77. 76. 75. 74.
 34. 85. 82. 82. 80. 79. 78. 77. 76. 75.
 35. 86. 83. 83. 81. 80. 79. 78. 77. 76.
 36. 87. 84. 84. 82. 81. 80. 79. 78. 77.
 37. 88. 85. 85. 83. 82. 81. 80. 79. 78.
 38. 89. 86. 86. 84. 83. 82. 81. 80. 79.
 39. 90. 87. 87. 85. 84. 83. 82. 81. 80.
 40. 91. 88. 88. 86. 85. 84. 83. 82. 81.
 41. 92. 89. 89. 87. 86. 85. 84. 83. 82.
 42. 93. 90. 90. 88. 87. 86. 85. 84. 83.
 43. 94. 91. 91. 89. 88. 87. 86. 85. 84.
 44. 95. 92. 92. 90. 89. 88. 87. 86. 85.
 45. 96. 93. 93. 91. 90. 89. 88. 87. 86.
 46. 97. 94. 94. 92. 91. 90. 89. 88. 87.
 47. 98. 95. 95. 93. 92. 91. 90. 89. 88.
 48. 99. 96. 96. 94. 93. 92. 91. 90. 89.
 50. 100. 97. 97. 95. 94. 93. 92. 91. 90.
 51. 101. 98. 98. 96. 95. 94. 93. 92. 91.
 52. 102. 99. 99. 97. 96. 95. 94. 93. 92.
 53. 103. 100. 100. 98. 97. 96. 95. 94. 93.
 54. 104. 101. 101. 99. 98. 97. 96. 95. 94.
 55. 105. 102. 102. 100. 99. 98. 97. 96. 95.
 56. 106. 103. 103. 101. 100. 99. 98. 97. 96.
 57. 107. 104. 104. 102. 101. 100. 99. 98. 97.
 58. 108. 105. 105. 103. 102. 101. 100. 99. 98.
 59. 109. 106. 106. 104. 103. 102. 101. 100. 99.
 60. 110. 107. 107. 105. 104. 103. 102. 101. 100.
 61. 111. 108. 108. 106. 105. 104. 103. 102. 101.
 62. 112. 109. 109. 107. 106. 105. 104. 103. 102.
 63. 113. 110. 110. 108. 107. 106. 105. 104. 103.
 64. 114. 111. 111. 109. 108. 107. 106. 105. 104.
 65. 115. 112. 112. 110. 109. 108. 107. 106. 105.
 66. 116. 113. 113. 111. 110. 109. 108. 107. 106.
 67. 117. 114. 114. 112. 111. 110. 109. 108. 107.
 68. 118. 115. 115. 113. 112. 111. 110. 109. 108.
 69. 119. 116. 116. 114. 113. 112. 111. 110. 109.
 70. 120. 117. 117. 115. 114. 113. 112. 111. 110.
 71. 121. 118. 118. 116. 115. 114. 113. 112. 111.
 72. 122. 119. 119. 117. 116. 115. 114. 113. 112.
 73. 123. 120. 120. 118. 117. 116. 115. 114. 113.
 74. 124. 121. 121. 119. 118. 117. 116. 115. 114.
 75. 125. 122. 122. 120. 119. 118. 117. 116. 115.
 76. 126. 123. 123. 121. 120. 119. 118. 117. 116.
 77. 127. 124. 124. 122. 121. 120. 119. 118. 117.
 78. 128. 125. 125. 123. 122. 121. 120. 119. 118.
 79. 129. 126. 126. 124. 123. 122. 121. 120. 119.
 80. 130. 127. 127. 125. 124. 123. 122. 121. 120.
 81. 131. 128. 128. 126. 125. 124. 123. 122. 121.
 82. 132. 129. 129. 127. 126. 125. 124. 123. 122.
 83. 133. 130. 130. 128. 127. 126. 125. 124. 123.
 84. 134. 131. 131. 129. 128. 127. 126. 125. 124.
 85. 135. 132. 132. 130. 129. 128. 127. 126. 125.
 86. 136. 133. 133. 131. 130. 129. 128. 127. 126.
 87. 137. 134. 134. 132. 131. 130. 129. 128. 127.
 88. 138. 135. 135. 133. 132. 131. 130. 129. 128.
 89. 139. 136. 136. 134. 133. 132. 131. 130. 129.
 90. 140. 137. 137. 135. 134. 133. 132. 131. 130.
 91. 141. 138. 138. 136. 135. 134. 133. 132. 131.
 92. 142. 139. 139. 137. 136. 135. 134. 133. 132.
 93. 143. 140. 140. 138. 137. 136. 135. 134. 133.
 94. 144. 141. 141. 139. 138. 137. 136. 135. 134.
 95. 145. 142. 142. 140. 139. 138. 137. 136. 135.
 96. 146. 143. 143. 141. 140. 139. 138. 137. 136.
 97. 147. 144. 144. 142. 141. 140. 139. 138. 137.
 98. 148. 145. 145. 143. 142. 141. 140. 139. 138.
 99. 149. 146. 146. 144. 143. 142. 141. 140. 139.
 100. 150. 147. 147. 145. 144. 143. 142. 141. 140.
 101. 151. 148. 148. 146. 145. 144. 143. 142. 141.
 102. 152. 149. 149. 147. 146. 145. 144. 143. 142.
 103. 153. 150. 150. 148. 147. 146. 145. 144. 143.
 104. 154. 151. 151. 149. 148. 147. 146. 145. 144.
 105. 155. 152. 152. 150. 149. 148. 147. 146. 145.
 106. 156. 153. 153. 151. 150. 149. 148. 147. 146.
 107. 157. 154. 154. 152. 151. 150. 149. 148. 147.
 108. 158. 155. 155. 153. 152. 151. 150. 149. 148.
 109. 159. 156. 156. 154. 153. 152. 151. 150. 149.
 110. 160. 157. 157. 155. 154. 153. 152. 151. 150.
 111. 161. 158. 158. 156. 155. 154. 153. 152. 151.
 112. 162. 159. 159. 157. 156. 155. 154. 153. 152.
 113. 163. 160. 160. 158. 157. 156. 155. 154. 153.
 114. 164. 161. 161. 159. 158. 157. 156. 155. 154.
 115. 165. 162. 162. 160. 159. 158. 157. 156. 155.
 116. 166. 163. 163. 161. 160. 159. 158. 157. 156.
 117. 167. 164. 164. 162. 161. 160. 159. 158. 157.
 118. 168. 165. 165. 163. 162. 161. 160. 159. 158.
 119. 169. 166. 166. 164. 163. 162. 161. 160. 159.
 120. 170. 167. 167. 165. 164. 163. 162. 161. 160.
 121. 171. 168. 168. 166. 165. 164. 163. 162. 161.
 122. 172. 169. 169. 167. 166. 165. 164. 163. 162.
 123. 173. 170. 170. 168. 167. 166. 165. 164. 163.
 124. 174. 171. 171. 169. 168. 167. 166. 165. 164.
 125. 175. 172. 172. 170. 169. 168. 167. 166. 165.
 126. 176. 173. 173. 171. 170. 169. 168. 167. 166.
 127. 177. 174. 174. 172. 171. 170. 169. 168. 167.
 128. 178. 175. 175. 173. 172. 171. 170. 169. 168.
 129. 179. 176. 176. 174. 173. 172. 171. 170. 169.
 130. 180. 177. 177. 175. 174. 173. 172. 171. 170.
 131. 181. 178. 178. 176. 175. 174. 173. 172. 171.
 132. 182. 179. 179. 177. 176. 175. 174. 173. 172.
 133. 183. 180. 180. 178. 177. 176. 175. 174. 173.
 134. 184. 181. 181. 179. 178. 177. 176. 175. 174.
 135. 185. 182. 182. 180. 179. 178. 177. 176. 175.
 136. 186. 183. 183. 181. 180. 179. 178. 177. 176.
 137. 187. 184. 184. 182. 181. 180. 179. 178. 177.
 138. 188. 185. 185. 183. 182. 181. 180. 179. 178.
 139. 189. 186. 186. 184. 183. 182. 181. 180. 179.
 140. 190. 187. 187. 185. 184. 183. 182. 181. 180.
 141. 191. 188. 188. 186. 185. 184. 183. 182. 181.
 142. 192. 189. 189. 187. 186. 185. 184. 183. 182.
 143. 193. 190. 190. 188. 187. 186. 185. 184. 183.
 144. 194. 191. 191. 189. 188. 187. 186. 185. 184.
 145. 195. 192. 192. 190. 189. 188. 187. 186. 185.
 146. 196. 193. 193. 191. 190. 189. 188. 187. 186.
 147. 197. 194. 194. 192. 191. 190. 189. 188. 187.
 148. 198. 195. 195. 193. 192. 191. 190. 189. 188.
 149. 199. 196. 196. 194. 193. 192. 191. 190. 189.
 150. 200. 197. 197. 195. 194. 193. 192. 191. 190.
 201. 201. 198. 198. 196. 195. 194. 193. 192. 191.
 202. 202. 199. 199. 197. 196. 195. 194. 193. 192.
 203. 203. 200. 200. 198. 197. 196. 195. 194. 193.
 204. 204. 201. 201. 199. 198. 197. 196. 195. 194.
 205. 205. 202. 202. 200. 199. 198. 197. 196. 195.
 206. 206. 203. 203. 201. 200. 199. 198. 197. 196.
 207. 207. 204. 204. 202. 201. 200. 199. 198. 197.
 208. 208. 205. 205. 203. 202. 201. 200. 199. 198.
 209. 209. 206. 206. 204. 203. 202. 201. 200. 199.
 210. 210. 207. 207. 205. 204. 203. 202. 201. 200.
 211. 211. 208. 208. 206. 205. 204. 203. 202. 201.
 212. 212. 209. 209. 207. 206. 205. 204. 203. 202.
 213. 213. 210. 210. 208. 207. 206. 205. 204. 203.
 214. 214. 211. 211. 209. 208. 207. 206. 205. 204.
 215. 215. 212. 212. 210. 209. 208. 207. 206. 205.
 216. 216. 213. 213. 211. 210. 209. 208. 207. 206.
 217. 217. 214. 214. 212. 211. 210. 209. 208. 207.
 218. 218. 215. 215. 213. 212. 211. 210. 209. 208.
 219. 219. 216. 216. 214. 213. 212. 211. 210. 209.
 220. 220. 217. 217. 215. 214. 213. 212. 211. 210.
 221. 221. 218. 218. 216. 215. 214. 213. 212. 211.
 222. 222. 219. 219. 217. 216. 215. 214. 213. 212.
 223. 223. 220. 220. 218. 217. 216. 215. 214. 213.
 224. 224. 221. 221. 219. 218. 217. 216. 215. 214.
 225. 225. 222. 222. 220. 219. 218. 217. 216. 215.
 226. 226. 223. 223. 221. 220. 219. 218. 217. 216.
 227. 227. 224. 224. 222. 221. 220. 219. 218. 217.
 228. 228. 225. 225. 223. 222. 221. 220. 219. 218.
 229. 229. 226. 226. 224. 223. 222. 221. 220. 219.
 230. 230. 227. 227. 225. 224. 223. 222. 221. 220.
 231. 231. 228. 228. 226. 225. 224. 223. 222. 221.
 232. 232. 229. 229. 227. 226. 225. 224. 223. 222.
 233. 233. 230. 230. 228. 227. 226. 225. 224. 223.
 234. 234. 231. 231. 229. 228. 227. 226. 225. 224.
 235. 235. 232. 232. 230. 229. 228. 227. 226. 225.
 236. 236. 233. 233. 231. 230. 229. 228. 227. 226.
 237. 237. 234. 234. 232. 231. 230. 229. 228. 227.
 238. 238. 235. 235. 233. 232. 231. 230. 229. 228.
 239. 239. 236. 236. 234. 233. 232. 231. 230. 229.
 240. 240. 237. 237. 235. 234. 233. 232. 231. 230.
 241. 241. 238. 238. 236. 235. 234. 233. 232. 231.
 242. 242. 239. 239. 237. 236. 235. 234. 233. 232.
 243. 243. 240. 240. 238. 237. 236. 235. 234. 233.
 244. 244. 241. 241. 239. 238. 237. 236. 235. 234.
 245. 245. 242. 242. 240. 239. 238. 237. 236. 235.
 246. 246. 243. 243. 241. 240. 239. 238. 237. 236.
 247. 247. 244. 244. 242. 241. 240. 239. 238. 237.
 248. 248. 245. 245. 243. 242. 241. 240. 239. 238.
 249. 249. 246. 246. 244. 243. 242. 241. 240. 239.
 250. 250. 247. 247. 245. 244. 243. 242. 241. 240.
 251. 251. 248. 248. 246. 245. 244. 243. 242. 241.
 252. 252. 249. 249. 247. 246. 245. 244. 243. 242.
 253. 253. 250. 250. 248. 247. 246. 245. 244. 243.
 254. 254. 251. 251. 249. 248. 247. 246. 245. 244.
 255. 255. 252. 252. 250. 249. 248. 247. 246. 245.
 256. 256. 253. 253. 251. 250. 249. 248. 247. 246.
 257. 257. 254. 254. 252. 251. 250. 249. 248. 247.
 258. 258. 255. 255. 253. 252. 251. 250. 249. 248.
 259. 259. 256. 256. 254. 253. 252. 251. 250. 249.
 260. 260. 257. 257. 255. 254. 253. 252. 251. 250.
 261. 261. 258. 258. 256. 255. 254. 253. 252. 251.
 262. 262. 259. 259. 257. 256. 255. 254. 253. 252.
 263. 263. 260. 260. 258. 257. 256. 255. 254. 253.
 264. 264. 261. 261. 259. 258. 257. 256. 255. 254.
 265. 265. 262. 262. 260. 259. 258. 257. 256. 255.
 266. 266. 263. 263. 261. 260. 259. 258. 257. 256.
 267. 267. 264. 264. 262. 261. 260. 259. 258. 257.
 268. 268. 265. 265. 263. 262. 261. 260. 259. 258.
 269. 269. 266. 266. 264. 263. 262. 261. 260. 259.
 270. 270. 267. 267. 265. 264. 263. 262. 261. 260.
 271. 271. 268. 268. 266. 265. 264. 263. 262. 261.
 272. 272. 269. 269. 267. 266. 265. 264. 263. 262.
 273. 273. 270. 270. 268. 267. 266. 265. 264. 263.
 274. 274. 271. 271. 269. 268. 267. 266. 265. 264.
 275. 275. 272. 272. 270. 269. 268. 267. 266. 265.
 276. 276. 273. 273. 271. 270. 269. 268. 267. 266.
 277. 277. 274. 274. 272. 271. 270. 269. 268. 267.
 278. 278. 275. 275. 273. 272. 271. 270. 269. 268.
 279. 279. 276. 276. 274. 273. 272. 271. 270. 269.
 280. 280. 277. 277. 275. 274. 273. 272. 271. 270.
 281. 281. 278. 278. 276. 275. 274. 273. 272. 271.
 282. 282. 279. 279. 277. 276. 275. 274. 273. 272.
 283. 283. 280. 280. 278. 277. 276. 275. 274. 273.
 284. 284. 281. 281. 279. 278. 277. 276. 275. 274.
 285. 285. 282. 282. 280. 279. 278. 277. 276. 275.
 286. 286. 283. 283. 281. 280. 279. 278. 277. 276.
 287. 287. 284. 284. 282. 281. 280. 279. 278. 277.
 288. 288. 285. 285. 283. 282. 281. 280. 279. 278.
 289. 289. 286. 286. 284. 283. 282. 281. 280. 279.
 290. 290. 287. 287. 285. 284. 283. 282. 281. 280.
 291. 291. 288. 288. 286. 285. 284. 283. 282. 281.
 292. 292. 289. 289. 287. 286. 285. 284. 283. 282.
 293. 293. 290. 290. 288. 287. 286. 285. 284. 283.
 294. 294. 291. 291. 289. 288. 287. 286. 285. 284.
 295. 295. 292. 292. 290. 289. 288. 287. 286. 285.
 296. 296. 293. 293. 291. 290. 289. 288. 287. 286.
 297. 297. 294. 294. 292. 291. 290. 289. 288. 287.
 298. 298. 295. 295. 293. 292. 291. 290. 289. 288.
 299. 299. 296. 296. 294. 293. 292. 291. 290. 289.
 300. 300. 297. 297. 295. 294. 293. 292. 291. 290.
 301. 301. 298. 298. 296. 295. 294. 293. 292. 291.
 302. 302. 299. 299. 297. 296. 295. 294. 293. 292.
 303. 303. 300. 300. 298. 297. 296. 295. 294. 293.
 304. 304. 301. 301. 299. 298. 297. 296. 295. 294.
 305. 305. 302. 302. 300. 299. 298. 297. 296. 295.
 306. 306.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION STATION AREA PLAN RATIO 1 RATIO 2 RATIO 3
 .10 .25 .50

HYDROGRAPH AT A1 .80 1 259. 648. 1295.
 (2.07) (7.34)(18.34)(36.68)(

2 259. 648. 1295.
 (7.34)(18.34)(36.68)(

ROUTED TC A2 .80 1 1678. 1977. 1954.
 (2.07) (47.52)(55.90)(55.34)(

2 70. 610. 1239.
 (1.99)(17.29)(35.09)(

ROUTED TC R1 .80 1 1674. 1974. 1951.
 (2.07) (47.51)(55.90)(55.25)(

2 70. 610. 1239.
 (1.99)(17.29)(35.09)(

ROUTED TC R2 .80 1 1602. 1884. 1864.
 (2.07) (45.39)(53.35)(53.78)(

2 70. 608. 1239.
 (1.99)(17.22)(35.09)(

APPENDIX 4

REFERENCES

LAKE TAMARACK DAM

1. Chow, Ven Te, Open Channel Hydraulics, McGraw Hill Book Company, New York, 1959.
2. King, H.W. and E.F. Brater, Handbook of Hydraulics, McGraw-Hill Book Company, New York, Fifth Edition 1963.
3. Lewis, J.V. and H.B. Kummel (1910-1912) Geologic Map of New Jersey, revised by H.B. Kummel, 1931, and by M.E. Johnson, 1950. New Jersey Department of Conservation and Economic Development Atlas, Sheet 10.
4. Louis Berger & Associates, Inc., Phase I Report, National Dam Inspection Program, September 1979.
5. Schway, G.O., R.K. Frevert, T.W. Edmister, and K.K. Barnes, Soil and Water Conservation Engineering, The Ferguson Foundation Agricultural Engineering Series, John Wiley and Sons, Inc., New York, 1966, 683 pp.
6. U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1) for Dam Safety Inspections Users Manual, Davis, California, September 1978.
7. United States Department of Interior, Bureau of Reclamation, Design of Small Dams, U.S. Government Printing Office, Washington, 1977, 816 pp.
8. U.S. Department of Interior, Geological Survey, 7.5-Minute Series (topographic) maps, scale 1:24000, Contour Interval 20 feet: Dover, New Jersey, (1954), Boonton, New Jersey, (1954).
9. U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No. 55, Washington, 1975.
10. U.S. Department of Commerce, Weather Bureau, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours", Hydrometeorological Report No. 33, Washington, 1977, 816 pp.

DISCLAIMER NOTICE

**THIS DOCUMENT IS BEST QUALITY
PRACTICABLE. THE COPY FURNISHED
TO DTIC CONTAINED A SIGNIFICANT
NUMBER OF PAGES WHICH DO NOT
REPRODUCE LEGIBLY.**